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**DENT**

# RESEARCH

## Don's diary

### The waste plastic into animal food two-step

by Clive Cookson  
science correspondent

Biochemists at Manchester University Medical School are investigating ways in which some of the quarter-million tons of plastic thrown away every year in Britain could be converted to protein for animal feed.

"They have developed two laboratory scale processes for making protein from waste plastics. Both involve a chemical step to convert the plastic to compounds that will support microbial growth, followed by a biological step to produce protein from these breakdown products.

Dr Bernard Brown of the Department of Medical Biochemistry, who is supervising the research, says its progress is being held up by lack of funds. Several industrial firms have sent representatives to look at the work but they have been put off by the fact that the processes are still some way from being economically viable.

The first involves boiling the plastic with nitric acid for a few hours. It is broken down into short-chain fatty acid molecules which can be dissolved in a culture medium for fermentation.

But work is now concentrated on the second, which is faster and less costly: the plastic is heated to 520 °C in a stream of oxygen-free nitrogen. This pyrolysis produces a mixture of short-chain hydrocarbons that can be emulsified and again incorporated in a culture medium. The process works for polyethylene, poly-



Plastic dinners for cows?

propylene and polystyrene, but not for polychloride.

Under the right conditions of temperature and acidulation, several species of bacteria can thrive on the breakdown products. The micro-organisms which are used in the process are not satisfied with the breakdown products, they rely on the year abroad waste plastic. The student with all hours and analysis shows that they are not satisfied with the breakdown products, they rely on the year abroad waste plastic. The student with all hours and analysis shows that they are not satisfied with the breakdown products, they rely on the year abroad waste plastic.

### France

the purpose of my trip to France is to visit third-year students working as language assistants all over France. But also going to try to fit in other pieces of business as I can. I expect to be too much and sleep too much but it is good for me.

Year abroad distinguishes language degrees from most other degrees. It provides a practical experience which is more characteristic of dentistry. But whereas dentists must feel a certain anxiety between lectures and sessions behind a desk, the modern student in the foreign country remote from the literary and translation exercise he usually she has been doing. And there is no one to check his fillings.

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### Nantes

I meet my students (lecturer and lecturer at the university under our exchange scheme). We look for the restaurant my wife enthused over last year. It is boarded up. Why do restaurants which close down provoke such pangs in me? I still haven't got over the demise of Schmidts in Charlotte Street.

We talk about police brutality when the university was on strike, the remoteness of French university teachers. Lecturers have some but not all of the problems of the assistants. This is their second bite of the cherry. Now both are looking for ways to stay in France.

We discuss their work: they still suffer from the belief that they should be holding "conversation

### Paris

The Bobino music hall in Montparnasse where Georges Brassens is singing; his new album is prominent in record shops all over France. The show is sold out for weeks ahead but I watch from the wings with a good view of the audience.

Unlike most Paris theatre audiences, they all seem to be French. There is a wide age span. Brassens sings 30 songs, including 10 new ones. The audience follows the words intently. It is like some religious rite: they know the ritual, they murmur the words (even of the new songs).

I am convinced that Brassens's enormous popularity is due to the feeling of group solidarity he produces: for two hours everyone in the audience feels an ideal Frenchman: tender and potent, fierce and irreverent, an instinctual opposer of authority, individualistic and yet speaking the same language.

My mind comes back to the question that has preoccupied me all the week. How does one become part of a group as closely-knit as this audience was? The key must be in the language and a readiness to share the group's living culture. The trouble is that assistants are excluded by the very nature of this culture which assumes certain knowledge, certain values. This tacit exclusion is what produces the group feeling. French assistants in Britain are in the same position of course: they come armed with Jane Austen and are disarmed by Alf Garnett.

### Cardiff

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Dr B. J. Brinkworth, reader in mechanical engineering, worked on solar energy as a matter of personal interest until the 1973 energy crisis. Since then he has set up the unit (of which he is director) and recruited 15 full-time staff for it.

The latest grant will enable Dr Brinkworth to extend his activities to include work on the control of solar heating (and cooling) systems, and on the use of density-stratified liquids as heat stores.

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### The Loire

The Loire Valley is for me one of the most beautiful parts of France. Duras and Resnais describe it perfectly in *Hiroshima mon amour*. The river banks are all defined; trees grow out of the water; everything is misty and shimmering. One day, 20 years ago, I saw hundreds of migratory geese, powdered with snow, drifting downstream like water-lilies in the sun.

I call at the Ecole Normale where I was an assistant in 1956. It is like a Hitchcock film (*Foreign Correspondent* or *North by North West*). Unchanged décor, different people. I have kept no friends from this period, though I remember the names, and I still have a print of one of the best photographs I ever took, a portrait of a *surveillant*—dark eyes, short hair, cigarette in an angle, sceptical for me, then, the quietness of his sophisticated Frenchness, experience and maturity.

One of my duties is to explain the details of a project we require while students are in France—a comparison of some aspect of French and British life. The main purpose is to provide an excuse for students to initiate situations where they contact French people and interview them.

In Cardiff we have set up a course for French assistants which has

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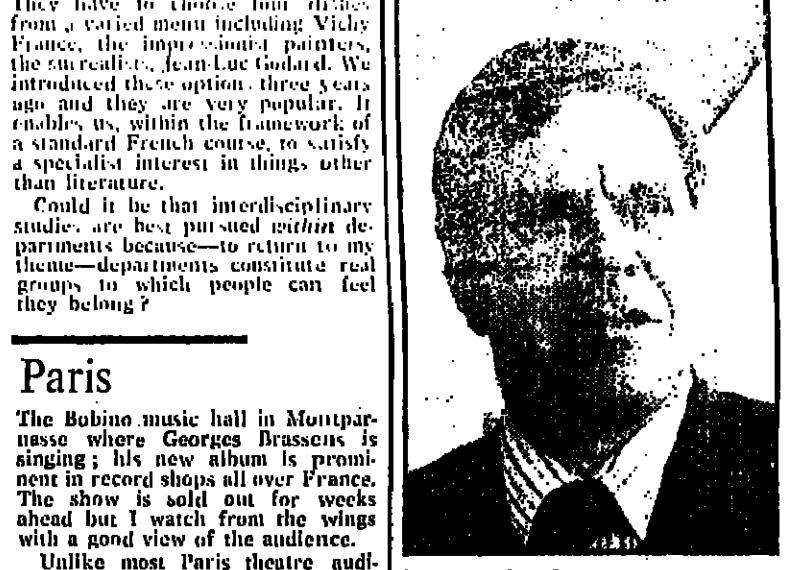
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## Reflections of an Anglophile



Martin Trow

I fell in love with England in the summer of 1948. A grateful, if slightly added, American government sent me for a course at the Technische Hochschule in Zurich as a reward under the GI Bill for three years of non-violent service in the US Navy during and after the Second World War.

My government may also have been under the illusion that I was still a mechanical engineer, the profession for which I had been educated but was already in the process of leaving (I had enrolled as a graduate student in sociology at Columbia University six months earlier). They were sending me to Zurich in order to... well, they did not know and neither did I. Perhaps neither of us cared very much.

It was my first trip across the Atlantic, and I was looking forward to it enormously. (In Zurich I remember watching a young Richard Crossman argue with an elderly Ronald Storrie about the future of Palestine and the Jewish State then aborning. Sir Ronald, who had been Governor-General of Jerusalem after the First World War, fascinated me, not only for his bearing and manner, which even I could sense were becoming rare in postwar England, but also for his views. He was the first genuine Arabist I had set eyes on.) But by the time I got to Zurich, everything that happened during the rest of that summer was an anti-climax compared with my discovery of England.

The old Dutch student ship which carried me and hundreds of other students till after the Civil War. But the sheer numbers of institutions are of a different order of magnitude than anything in Britain or on the Continent. What we are seeing is not the mark of a new society but the re-establishing of important state institutions in Berlin or Paris or London, closely linked to a church, or the law, or the Civil Service. What was happening much more closely resembles the response of small capitalist entrepreneurs to an emerging and uncertain market, where supply may (with luck) help create demand.

British and American systems of higher education today resemble each other in many ways: we both have great universities and technological institutions with comparable standards of teaching scholarship and scientific research; we both have professors and departments, and a greater degree of institutional autonomy than most Continental universities enjoy. (And your vice-chancellors are more like our college presidents than either are like the rectors or even the new university presidents on the Continent.)

But these similarities conceal enormous differences between our systems and institutions. And none of these differences is more important than this: that our system was born in the environment of a sensitive to the needs, interests and demands of the "consumers" the students, in that market. And if I have learnt anything after 15 years of viewing America through my English prism, it is how powerful and pervasive is the role of education, as compared with its influence in Britain (or anywhere else). It even affects how we greet one another, in corridor or common room.

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France, and not of post-war America and its people and institutions.

I remember, for example, all courses in the common room of an Oxford college, the embarrassment of English academics in the face of unimpaired, uncheated, unimpaired encounters with others.

There are many more profound differences between England and America, than this, yet what strikes a visitor first is how the natives react to him. To my very great surprise, my very "colleagues" in Oxford did not behave as Americans would in their place. They did not come up and "press the flesh", ask eagerly for my name, my subject, my research interests, where I came from, where I was living at the moment, nor effluently my trip over was, would I like to come to the house for a drink, for lunch, for dinner, to meet the wife/kids/girl-friend/et cetera, et cetera. And to my surprise, I found myself very much needing that kind of reception, or at least some connexion with what I took to be my academic "hosts".

Then, rather beyond my own will, I began accessing these shy, inoffensive dons, introducing myself, reaching down to grasp a hand—unwittingly but unresponsive—to pump it and thus assure myself that I was actually there and welcome to be there, a guest whose existence had been recognized, ratified, legitimated. And afterwards two questions came to mind—first, what was causing this peculiar academic embarrassment, and so often masquerading as indifference or polite self-assurance; and, second, what required me to behave in such a grotesque, even barbaric way, to reach out, seize and shake reluctant hands, and to behave altogether like a stage American.

With those two questions, repeated in different situations and about different matters hundreds of times on subsequent visits, my mind went back to the United States, to the differences between America and its institutions and its culture, and of myself as an American, was begun.

The peculiarities of our system of higher education are often not visible to the unaided American eye. To us, everything looks perfectly natural and reasonable. For example, a recent review of the American college curriculum observed that in the United States had "only 250 colleges at universities" at the outbreak of our Civil War. I suppose the author meant only 250 by contrast with the 1,000 institutions we had established by 1910, or the 3,000 of today. Nor did he mention that the 250 were the survivors of some 700 colleges that had been crated in the new nation between our War of Independence and the Civil War—the rest had simply failed.

It is true that our colleges before the Civil War were for the most part poor malnourished things; and we did not have a genuine university till after the Civil War. But the sheer numbers of institutions are of a different order of magnitude than anything in Britain or on the Continent. What we are seeing is not the mark of a new society but the re-establishing of important state institutions in Berlin or Paris or London, closely linked to a church, or the law, or the Civil Service. What was happening much more closely resembles the response of small capitalist entrepreneurs to an emerging and uncertain market, where supply may (with luck) help create demand.

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DENT



# Time for conscious decision on links with developing world

The point of the report presented to the Inter-University Council for Higher Education Overseas by Sir Michael Swann's committee last week is that both the universities and the Government need to make a "conscious decision" about higher education links with the developing world.

The particular reason for this is that the IUC's work in Africa and South-East Asia belongs to a period of history now ending. Such a view, which emphasizes the fact that the IUC was set up just after the Second World War as part of the process of "decolonization", is widely held and not least in the British Council and the Ministry for Overseas Development.

The council carries out the bulk of British overseas educational liaison and the ODM supports the IUC's work to the tune of £3m a year.

The IUC was set up to aid the establishment of university-level institutions in East and West Africa and other former colonial territories. Over the years it has adapted from its initial academic advisory role to that of providing courses for administrators and lubricating the process of academic exchange between new universities such as Ibadan in Nigeria and institutions in this country.

The colonial paragon does not always mature into the partnership of academic equals. The Swann committee reported how attitudes at home to the British aid effort have changed and hinted that not all universities were willing to make the effort that had-on requires.

Sir Michael's committee stepped delicately into an area of controversy, the institutional overlap between the IUC and the British Council. Evermore — Mr Richard Griffiths, director of the IUC, Sir John Llewellyn, director general of the British Council, and Mr Jack Thornton, chief education adviser to ODM — deny there is "conflict", and indeed these three are old friends and colleagues. But Swann nevertheless found "an unsatisfactory geographical and institutional division" between the two councils and recommended action be taken.

The committee's conclusion was bedded about with qualifications but it still produced two alternative plans. The first was to keep the IUC as it is and bolster its work liaising between universities in the West Indies, Malaysia and Africa and those at home.

"We believe", the report said, "that the most satisfactory organizational arrangements, both for the efficient harnessing of the interests and resources of British universities and polytechnics and for pursuing the broad objective of improving international, but non-governmental, relationships with developing countries, would be to keep the IUC in existence such as it is today; but to expand selectively its geographical coverage and to reduce as far as possible other constraints on its operational freedom."

But next the committee, guided perhaps by Sir Michael Swann and Mr Griffiths, decided to take account of what was politically feasible. Present arrangements are unworkable; the ODM has come to see little justification for aid finance being used for university liaison that properly comes under the "cultural cooperation" heading which to the Public Expenditure Survey Committee means the British Council.

significant restructuring of both the British Council and the IUC into a single new organization within which all distinctive higher education work involving support from British universities and polytechnics would be separately consolidated.

The form this merger might take is indicated by administrative arrangements the British Council already has. Swann's fear was that without a body of their own such as the IUC, academic interests would not be fully represented, but in fact the British Council services two committees made up of autonomous academics—one for Commonwealth university interchange and the other for academic interchange within Europe—in a mutually satisfactory way. At least, as a council official pointed out, Mr Jack Butterworth, the vice-chancellor of Warwick who is also chairman of the IUC, sits on the British Council's Commonwealth committee and there have been no complaints.

The council observes Whitehall do not officially say much about the Swann recommendations until, and if, the IUC approaches it. Even then there would be a whirl of discussions involving its board, the ODM, the Foreign Office, Department of Education and, it is to be hoped, the overseas countries concerned before such a merger could take place.

Meanwhile the council points out the utility of giving a single body the main responsibility for educational liaison at all levels from primary to higher. Sir John Llewellyn said he was "a little unhappy" with suggestions that tertiary education should be split off. The council agrees both in theory and in the practice of its work in countries such as India and Bangladesh that the success of higher education depends on the raw materials it gets from the schools—and hence the pedagogical methods of the schools might have had from Britain.

The Swann committee seemed to accept the force of this argument but laid down strict conditions for any merger. It recommended a committee for inter-university and polytechnic cooperation within the British Council should have its own operational budget; be given an advisory role in higher education links with all overseas countries; guarantee the rights of existing IUC staff and take over various responsibilities of the ODM.

The ODM, however, came in for some criticism for its policy of emphasizing "developmental" needs in educational aid overseas. As spelled out by Mr Prentice and his successor at ODM, Mr Judd, this means aid for basic and vocational education and the promotion of staff exchanges only in those subjects of direct benefit to a country's agriculture, commerce or industry.

Swann said: "Our view on this point is clear and we hope donors will accept it. Universities are concerned *inter alia* to produce high-level educated manpower for the community and also to act as resource centres of staff and facilities for the attraction of students from both this and the next generation of national and international students."

So with obvious reluctance the committee said: "It seems unjust between the IUC and the British Council were to be insisted upon by the Government, the only form which would be likely in our view to succeed in meeting the required broad national objectives effectively would be one which involved a

"At this level—and we are only referring to staff and students of the highest quality—all disciplines are developmental in that they form a suitable vehicle for the training of most of the future leaders, in any walk of life, in the community."

"In short, we would deplore the over-rigid application by aid donors of concepts of 'relevance' or of 'developmental subjects' in selecting activities and people for external support at the highest levels of scholarship and education."

ODM officials, who will be advising their minister on a response to Swann in the next few months, counter this by talking politics. The least-developed countries themselves are putting less emphasis on their universities as opposed to technical training and higher education; they increasingly want to deal with Britain government-to-government, not through some intermediate agency. Can we assume the British concept of higher education is what most these countries need? Why does the IUC spend so much on exporting British academics for spells abroad rather than training foreign academics in universities here?

Another point made by ODM people is that they are all in favour of prosperous academic interchange but it is not part of this country's aid programme. It is "cultural cooperation" and belongs under a different vote in these days of cuts the nuances matter.

This view contrasts harshly with a more expressed view of the Swann report—that once in a future for cooperation between academic institutions without government being involved and scholars talking in scholars through their own private channels.

"We believe the report said that in the field of international relations generally, insufficient regard tends to be paid by governments today to the value and effectiveness throughout society of direct contacts between groups of people sharing common interests in scholarly and professional activities which are conducted entirely outside the inter-governmental structure of relationships."

The logic of such an argument is partly taken by the committee. It is for the universities to take the IUC away from government finance and run it entirely themselves, or at least with the polytechnics cooperating. Alternatively some central overseas services unit could be set up in addition to existing bodies which would work with improved arrangements within universities for overseas liaison.

Yet Swann recognizes that such a sanguine view of the future of university involvement in education overseas requires a new attitude in some places and a course of money to be made available. One imperative is to tidy up the mechanism for lubricating and coordinating the universities' overseas role.

It seems likely, whether Swann is entirely happy with it or not, that this would work with the ODM. Whitehall will agree with the ODM official who said: "Ultimately the whole game is the British Council."



Essex University: will go bankrupt without fees increase.

## Fees fight starts with everyone on same side

A full-scale student campaign is now under way to prevent universities from implementing the fee increases proposed by the Government for next October. On the face of it, it looks like another battle between students and university authorities, but in fact universities are generally sympathetic to the students' plight. Several universities—Essex, Southampton, Lancaster, Leicester and Aston—have come out against fee increases, while others, such as York and the University of Ulster, are setting up working parties to find ways of softening the blow.

Action is more difficult, however, because universities' hands are tied: their income for next year will be adjusted according to the amount they are expected to reap from the higher fees, which now represent a much higher proportion of their income—20 per cent as opposed to 7 per cent until previously.

Essex University has calculated that if it does not increase fees the university will go bankrupt. Its income from fees would be £510,000 compared with £1,455,000. The difference would have to be made up by the university.

Ways are being found, however, of spreading the burden of the higher fees more evenly. The students' ultimate aim is for the abolition of fees entirely; meantime they are pressing for a commitment from university senates on two fronts: no differential in fees for home and overseas students, and no increase for self-supporting students.

There are roughly 34,000 overseas students in British universities, some 25,000 of them financed privately, including sponsorships and bursaries. Self-supporting British students account for 10,000 of the total 33,000 British postgraduates, and 22,000 of the 208,000 British undergraduates.

One possibility is juggling the books, so that overseas students pay less and home students pay more. Brunford University has had the same fee for home and overseas students for three years. This year, when fees for home students went up from £140 to £360, and for overseas students from £182 to £416, Brunford charged £219 for all students, a £44 increase on its previous fee of £175. This cost the university £150,000. Because the home/overseas differential for next year will be smaller, the cost would be less—some £75,000—and the fee would again have to be increased.

Mr Stephen Pearson, the president, said the figure for undergraduates might end up at £300 and for postgraduates £750, with possibly a lower fee for self-financing students. One British student in five on advanced courses is self-financed, and the figure is higher for overseas students.

academics use ivory towers self-defence; others use them as forums for addressing the world, thriving on the controversy that they are able to create. Commener, professor of environmental sciences at Washington University, St Louis, Missouri, director of the university's centre for the Biology of Natural Systems, falls firmly into the latter category.

Commener's concern for the way ivory uses science and technology in his starting role in the great environmental debate that began in the early 1970s, including an appearance on the cover of *The Closing Circle* focused on the design of the production system as the origin of our environmental problems. But there was a need to realize production in terms of its energy impact", Professor Commener explains.

"The most difficult problem is not to analyse the production of energy but its use, and this requires a total analysis of the production system, looking for example, at developments in agriculture, in transportation and in the petrochemical industry.

"One of the lessons we learnt in trying to do this was the need to bear in mind the complex interactions between the various systems. This meant looking at each subject firstly in terms of its resource implications, secondly its production aspects, and thirdly its economic governance."

Professor Commener's approach has two important aspects, both of which characterize the research (and teaching) activities of the Centre for the Biology of Natural Systems, and both of which he claims, have put him at variance with the academic establishment. The first is multidisciplinary. The centre brings together specialists from a number of areas, from solar energy to economics, to work jointly on research programmes.

"Secondly, we are concerned to present solutions to problems in the real world, not merely to theorize about them, and this also seems to have upset a lot of people whose activities are implicitly criticized in our work", Professor Commener says.

The crucial wall that Commener attempts to breach, and of which this event is a symptom, is that which divides science from politics.

David Dickson talks to Professor Barry Commener, author of 'The Poverty of Power'

US devil's advocate for new look at energy use

into the programme of the British Labour Party.

The basic need, as he sees it, is for a centralized planning mechanism through which a coordinated energy policy can be articulated. In practice, this means the nationalization of the energy industry; Britain's main mistake, he claims, is to have "nationalized the least profitable industries, and then retain the criterion of profitability".

The main purpose of his intervention into political debate has been to raise discussion of critical issues about energy use and the economy, he says. "I do not think that socialism is the issue of the day in the United States; people are more concerned about unemployment."

"But you need the mirror of socialist analysis to hold up our problems. In my book I have been less concerned to present a detailed programme for the future than to diagnose the present. I feel I have raised the main issues; the next step should be their substantial investigation."

Certainly he is no stranger to the corridors of industrial power. A busy schedule since the American publication of the book last spring has ranged from three days spent with the corporate planners of the General Electric to his appointment as a member of the advisory council to the Secretary of Commerce, former ambassador Mr Elliot Richardson.

But whatever the reaction to Professor Commener's political views, there is nothing but praise for his abilities as a teacher. *The Poverty of Power*, like his earlier books, is characterized by a rare lucidity of explanation.

The same skill is displayed in the lecture room. His presentations of complex statistical data—for example, of the energy inputs and outputs of American agriculture, and so in terms that would fit squarely



Professor Commener.

The link was made implicitly in *The Closing Circle*; in *The Poverty of Power* it becomes explicit that his target is American capitalism.

"In dealing with both the energy crisis and the current economic crisis, what we are really dealing with is the substitution of labour by capital", Professor Commener says. "My guess is that so long as capitalism involves the freedom of the individual to maximize profit, we need a miracle if it is also going to mean maximizing the desirable use of energy."

Such phrases have drawn predictable headlines such as "Industries grab profits, waste energy", "Commener and 'Ecologist' blames capitalism for energy crisis". American reviewers have also reacted with scepticism: *Time* claimed Commener was "better as godly than economist", and the *New York Times Book Review* advised its readers to "read him for the science, pass up the economics".

Yet he is no revolutionary. When he uses the term socialism he does so in terms that would fit squarely

## Media men and academics meet in Jamaica for training

Supplementing the hardship they receive from the University Grants Committee is another source of help. It is not known how much of the £100,000 budget for 1977-78 will be set aside as a supplementary grant for hardship funds, although Mr George Orkney, Minister of State Overseas Education, mentions a figure of £1m when announcing the new fees in November. Aided by the Friedrich Ebert ship element grant, but the UGC's block grant, but the year is the first time a figure has been mentioned. It might be divided roughly between the UGC and local authorities.

But this sum is likely to be short of what is needed. Mr George Orkney, secretary of the Overseas Education, mentions a figure of £1m when announcing the new fees in November. Aided by the Friedrich Ebert ship element grant, but the UGC's block grant, but the year is the first time a figure has been mentioned. It might be divided roughly between the UGC and local authorities.

Manchester University has applied for this year at least to supplement its hardship fund from the UGC with another £10,000, having stated that a more realistic sum for hardship money is £31,000. The position next year is to be reviewed.

One other way to stem the tide of change is to encourage the quality of research—its to increase part-time provision. It is argued that the increase in fees will be the emphasis of postgraduate training was the present and future of the universities, particularly in the Caribbean, Guyana and Puerto Rico.

Philip Radcliffe

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Students overseas: patronage or partnership?

Francis Gil













The Times Higher Education Supplement (London) Room 541 National Press Building Washington DC Tel: (202) 638 6765

### Carnegie survey confirms campus conservatism

The general public impression of an increasingly conservative outlook among American students has been given the academic imprimatur with the publication of a massive new survey made in 1975 that is directly comparable to one made in 1969. It found that in that time the proportion of undergraduates classifying themselves as "left" or "liberal" has fallen, the overall satisfaction of undergraduates with their colleges has increased and interest in radical academic reform has waned. The survey of 25,000 lecturers, 25,000 undergraduates and 25,000 graduate students was directed by Professor Martin Trow from the University of California at Berkeley, and was sponsored by the Carnegie Council on Policy Studies in Higher Education. In 1975 some 71 per cent of students said they were "satisfied" or "very satisfied" with their colleges. This is more than in 1969, but even then, at the height of campus unrest, more than 60 per cent said they were satisfied. Although the proportion of undergraduates expressing leftwing beliefs has fallen from 44 to 35 per cent, it remained the same for both graduates and lecturers at 43 and 41 per cent respectively. On one vital issue, opinion has changed sharply: race. There is still strong support for the proposition that "any institutions with a substantial number of black students should offer a programme of black studies if they wish it." But the proportions agreeing, even with some reservations, that "more minority group undergraduates should be admitted to my college even if it means relaxing normal academic standards for admission" have fallen from 29 to 22 per cent among undergraduates, from 37 to 20 per cent among graduates and from 37 to 27 per cent among teachers. There was also a general decline in support for the proposition that "the normal academic requirements should be relaxed in appointing members of minority groups to the faculty". These changes reflect some of the controversy, especially in the early years, that has surrounded the working of "affirmative action" and the less happy results of special admissions criteria for minority students. Favourable attitudes towards women on the campus seem to have strengthened between 1969 and 1975. By 1975, fewer than one in 10 lecturers or graduate students agreed that "the female graduate students in my department are not as dedicated as the males." Professor Trow's report vividly documents the "major inflation" that has been in college teachers' salaries in recent years. The report says that nearly three out of five undergraduates in 1975 reported a "B" or better average, as compared to a little more than one in three in 1969. Among graduate students, 57 per cent claimed an average of "A" plus or better in 1975 while 40 per cent reported such grades in 1969. Interest in radical academic reform has fallen. In 1969 a third of teachers agreed that undergraduate education would be improved if grades were abolished. In 1975 the proportions of students and teachers endorsing that idea dropped to less than one third for students and to about one fifth for teachers. The survey also confirmed the growing interest in vocational courses. In 1975 undergraduates were more likely than they were in 1969 to take "training in skills for an occupation" and "vocational courses of a special field" as the educational objectives that were most important to them. Another main finding of the survey was that although very large proportions of all three groups in 1975 said that "teaching effectiveness and not publications should be the primary criterion for the promotion of faculty members", the proportion of teachers themselves who feel that has dropped from 86 per cent to 76 per cent since 1969.

### Research councils may split

A second reading will be given by Parliament after it reassembles on Monday to a Bill to split up Canada's research councils. Its supporters hope it will become law by the spring. The Bill—C-26—divides the research activities of the National Research Council from its funding powers. The smaller Canada Council will be split in two, retaining responsibility for the arts, the humanities and social sciences will come under a new council. The Medical Research Council, itself an offshoot of the NRC, remains largely unchanged. It will continue to administer research funds and scholarships for universities, together with the new Social Science Research Council (split from the Canada Council) and the National Science and Engineering Council (split from the NRC). All three bodies involved in university funding will be grouped together in a new coordinating committee which will try to ensure that interdisciplinary research does not fall between the funding stools. These arrangements have nothing to do with the amount of money available for research. That has been a matter of great argument in government grants and only authorized a small increase for medical research after an intensive lobbying campaign last spring.

### Chicano college up for sale

In spite of last-minute attempts to save it (THESE, December 24) the only Chicano (Mexican-American) college in America has been put up for sale. The Colegio Cesar Chavez in Mount Angel, Oregon, unable to make payments on a \$1m mortgage from the government, was sold by the regional office of the Department of Housing and Urban Development. The site, buildings and 10-acre campus would have to be sold.

### Arctic Institute move approved

Alberta has at last decided to provide funds for the Arctic Institute, a prestigious research organization that moved from McGill University to the University of Calgary in 1975 on the understanding of provincial support (THESE, March 25, 1976). The provincial government has now decided to give both institutions \$160,000 a year for three years. A government council has also been set up to coordinate the work.

### Protests grow over tax perk proposals

The proposal by the Internal Revenue Service to levy income tax on the free tuition given by universities to the children of thousands of university teachers has caused howls of academic outrage (THESE, December 3). Many universities do not charge tuition fees for the children of university teachers—often with reciprocal arrangements between colleges. According to the National Centre for Educational Statistics about 27,000 students are educated free under this scheme. The regulation would affect about 800 colleges, most of them private. Free tuition is one way institutions are able to attract good teachers at comparatively low salaries, and any change is seen as a threat mainly to the private sector. Official statistics, however, show that some 175 public institutions receive tuition remission last year worth over \$20m—more than the amount given by the 632 private institutions that had similar schemes. The AAPP is particularly upset that the Treasury's original intention to tax fringe benefits for airline employees, car salesmen, people working in clothing, and others has been dropped. But the Treasury is still going ahead with the tax on the value of free tuition programmes. The AAPP, in evidence at a public hearing on the proposal earlier this month, reminded the IRS that in 1954 Congress explicitly referred to tuition remission as a form of scholarship. As such it is not taxable. Stanford University, warned the IRS in a letter that overriding Congress's wishes would lead to lengthy court cases.

### Major inquiry initiated into overseas students

A major study of foreign students in Canada has been commissioned by the semi-governmental Council on International Education. It comes at a time when the volume of overseas students and controversy in Canada. The study will be in three parts: an analysis of statistics, interviews with foreign students and a number of monographs. The findings will be coordinated into a full report by Dr Myer Horowitz, academic vice-president of the University of Alberta. Foreign students are a hot political issue in the past few months there have been a number of provincial and federal government actions which suggest increasing restrictions: visa regulations have been tightened up by a recent Immigration Act, a growing number of universities are setting ceilings on the number of foreign students they accept, and the two provinces of Ontario and Alberta are considering differential tuition rates for foreign Canadian students. The problem is that Canada does not have any national policy on how many foreign students it should accept, and with the economic squeeze and the standstill in university expansion there is a general belief among the public that it now has too many. This has been exacerbated by trends in immigration which bring many more people from the Third World than from Europe. There has been a consequent deterioration in race relations within Canada. A recent conference on Third World students Dr Michael Oliver, President of Carleton University, said were part of a general feeling about immigration. The tolerance level for Third World students had been reduced because people had confused them with immigrants from non-white backgrounds. The total of foreign students is not known, as not all universities record their students' backgrounds and citizenship, but official statistics suggest that "visa students" as they are called, make up between 4 and 5 per cent of the total undergraduate population, or little over 20,000 people. In 1965 there were about 7,000 foreign students in Canada. Their numbers increased steadily till 1972 with a dip in 1970. In 1973 they again went down, but in the next two years went up by 20 to 40 per cent. Recent reports suggest there were 10 per cent more in 1976. The subject areas attracting the most foreign students are the social sciences, engineering and general arts and sciences. The two English-speaking universities, Quebec, McGill and Concordia, together with the University of Toronto, have the largest number of foreign students. The largest group of visa students come from Hongkong. They make up 26 per cent of the total, and have increased by almost a third in the past three years. This influx is partly explained by the fact that only a few thousand students are able to enter the two provinces. The next largest group—about 25 per cent—comes from the United States. About 9 per cent come from the other developed countries. World students make up about 30 per cent of all foreign students. On the 13 per cent come from the poorest and least developed countries. The Canadian government sponsors fewer than 10 per cent of all foreign students. The question of raising foreign students' fees caused considerable controversy. The Ministry of Colleges and Universities has set fees for foreign students at \$1,000 a year, double that of Canadians. The new rate begins this month. A similar differential has already been introduced in community and junior colleges. Students who have already begun courses can complete them at the old rate, so the full differential will not be in operation until 1980. By then the Ministry estimates it will save up to \$7m. Ontario universities that object to the increases do have a way out, reducing support grants to students from each foreign student; the institution can therefore either pass on the higher tuition fees or keep the same rate and raise the money elsewhere. There are some important exceptions to the new differentials. Students sponsored by the Canadian International Development Agency and the United Nations will be exempt, as will the children of diplomats and those on work per-

### Henry Ford resigns as Foundation trustee

Henry Ford II has resigned as a trustee of the Ford Foundation, thus ending the link between the world's largest charitable foundation and the dynasty which founded it 40 years ago. In a statement last week he strongly criticized the Foundation for spreading its money too thinly, and for not supporting capitalism and the system of free enterprise. The Foundation is a creature of capitalism, Mr Ford said. "It is hard to discern the Foundation's role in anything the Foundation does. It is even more difficult to find an understanding of this in many of the institutions, particularly the universities, that are the beneficiaries of the Foundation's grants programme." The Ford Foundation has played a major role in the development of education in America, funding a vast number of research projects, stimulating innovation, sponsoring studies, experiments, pilot projects and a number of important semi-permanent education projects. Although it might be considered to be less "activist" than the smaller Carnegie Foundation, it has clearly become too committed to liberal causes for Mr Ford's liking. He questioned the Foundation's relationship to the American economic system which yielded the funds on which he said "it exists and thrives". He said "perhaps it is time for the trustees and staff to examine the question of our obligations to our economic system, as well as the system's most prominent offspring, might act more wisely to strengthen and improve its progenitor." Mr Ford also suggested the Foundation, which suffered badly during the recent economic recession, cut back its activities in keeping with its diminished resources. He said though the Foundation only about half the income 10 years ago, it was still spending more money than ever on many different questions.

### Laval strike go back

The record-breaking strike at the University has ended in a complete victory for the staff. Agreement came after a day from Quebec's University. The demands of the teachers' union, which did not accept, was that the strike should be replaced by a system of shared responsibility. The 107-day-long strike was mainly on the question of faculty mental power and authority. The sole focus of defence thinking in this country is the truly and inescapably desperate situation that would come about as a result of a failure of NATO's policy of deterrence. Any proposal in the defence field must be viewed in this light; one must ask, above all, whether it would contribute to deterring the development of such a situation and, secondly, whether it would enable us to defend ourselves or to survive the holocaust as on the day when we may not occur. The citizen who agrees with the broad outlines of his government's defence policy should feel an obligation to assist it. Should it fail in its aim of deterring war, all other policies, however beneficial, would turn to dust and ashes. Indeed, a citizen engaged in almost any type of useful work helps to promote the security of his country, whether his work strengthens the economy, educates new and responsible citizens through bringing up or teaching children, or reinforces the feeling of cohesion of the community through social service. Naturally some forms of this assistance are more direct than others, and the most immediate are service in the armed forces, contributing to their administration or supporting them through research and development as a scientist or engineer in the Ministry of Defence or in the defence-related industries. All of us in the defence world, but particularly perhaps the scientist and engineer, must be aware that in devising and building ever more refined weapons and in training troops to use them, one is



Hermann Bondi: "The scientist's role in defence"

# The British Association

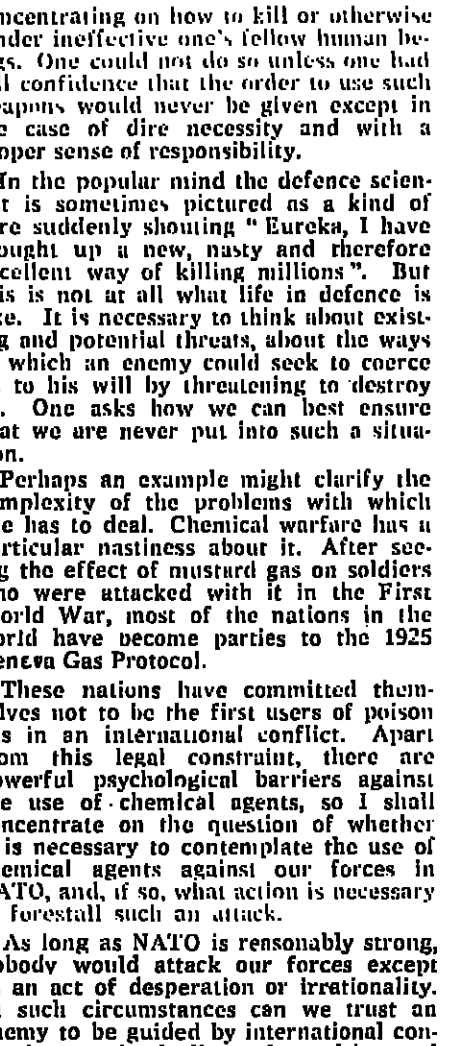
## FOR THE ADVANCEMENT OF SCIENCE

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### The scientist's role in defence

by Hermann Bondi

concentrating on how to kill or otherwise render ineffective one's fellow human beings. One could not do so unless one had full confidence that the order to use such weapons would never be given except in the case of dire necessity and with a proper sense of responsibility. In the popular mind the defence scientist is sometimes pictured as a kind of ogre suddenly shouting "Euroka, I have thought up a new, nasty and therefore excellent way of killing millions". But this is not at all what life in defence is like. It is necessary to think about existing and potential threats, about the ways in which an enemy could seek to coerce us to his will by threatening to destroy us. One asks how we can best ensure that we are never put into such a situation. Perhaps an example might clarify the complexity of the problems with which one has to deal. Chemical warfare has a particular nastiness about it. After seeing the effect of mustard gas on soldiers who were attacked with it in the First World War, most of the nations in the world have become parties to the 1925 Geneva Gas Protocol. These nations have committed themselves not to be the first users of poison gas in an international conflict. Apart from this legal constraint, there are powerful psychological barriers against the use of chemical agents, so I shall concentrate on the question of whether it is necessary to contemplate the use of chemical agents against our forces in NATO, and, if so, what action is necessary to forestall such an attack. As long as NATO is reasonably strong, nobody would attack our forces except as an act of desperation or irrationality. In such circumstances can we trust an enemy to be guided by international conventions or by feelings of revulsion and therefore to refrain from using chemical warfare? Clearly the greater the military advantage he would gain by using chemical agents, the greater the temptation for him. Until such time as there is agreement on a comprehensive and verifiable ban on the holding of chemical weapons, of the kind envisaged in the British draft recently tabled at Geneva, we cannot ignore the possibility, and we must take steps to diminish the temptation. First, we can use direct defence; that is taking steps to reduce the effectiveness of his chemical agents. If our troops are well provided with gas masks, protective suits and vehicles designed to prevent the ingress of the agents, if they are well trained in the use of all this equipment, and if the enemy knows this, then he will appreciate that he could gain little advantage through the use of chemical warfare. Secondly, if this were judged insufficient to deter the aggressor, a capability and willingness to retaliate in the same manner would be the next step. Third would come the threat of retaliation by raising the level of violence (as from non-nuclear to the use of theatre nuclear weapons). Where does the scientist come into all this? Evidently, in the first instance, he devises protective clothing and so on.



John Grimwade

This sounds innocuous and inoffensive, but how can one be sure that the protection provided is effective? Surely only by establishing, through theory and experiment, which potential chemical agents the enemy might use, and then testing the effectiveness of an equipment against these agents. Even this must involve the manufacture, on a very small scale, of the agents themselves. If one wanted a retaliatory capacity, large-scale production would be necessary, together with deployment, lowering the barriers much further and making the enemy fear that we were seriously contemplating the first use of the weapons. Where does the balance of risk lie? The United Kingdom choice has been to go for deterrence by protection, while working for international treaties (properly inspected and enforced) so that the spectre of chemical warfare may eventually be banished totally. Where in all this does the scientist stand? Should he go on strike if asked to work in this field? Should he try to coerce his government, by his refusal to work on these matters, to adopt a policy (whatever this may be) more to his liking? Quite apart from the virtual impossibility of getting scientists to act sufficiently in unison (for the spectrum of their political views is as wide as that of the general public), there can be something undemocratic and arrogant in an assertion that one's own views must prevail over the policy for which a government is responsible to the elected representatives of the people. Surely the scientist's duty is not to set himself up in opposition to the politician, but to form a team with him, working hard to make those carrying the political responsibility understand the dangers and risks he knows about and (which is more difficult still) explaining where the inevitable gaps in his knowledge lie. The ethical duty of the scientist lies in explaining, in making the big effort in thinking and thought to make clear the essentials and especially the risks of any actions, their foreseeable consequences and the areas where the consequences cannot be foreseen, but where years may be appropriate. His political judgment is no better than that of any other citizen and his moral convictions are as important, neither more nor less, as those of anyone else. It is solely in his scientific knowledge and judgment that he has anything special to give. This he must give, with the greatest precision and clarity. That is his inescapable duty. The temptation is ever-present to shade his judgment so that his advice assists the project he likes technically, or which fits in with his political or military leanings. These temptations he must resist. Equally, he must convey his judgment differs from other scientists whose judgment differs on a point of scientific debate. Science must not be presented as monolithic or as magic, but as human and arguable. One's obligations of citizenship and one's duty as a human being can be well discharged in defence science, but only provided that one does not regard one's special scientific qualifications as conferring a special standing and understanding in matters of public policy. Sir Hermann Bondi is chief scientific adviser to the Ministry of Defence.

- D. O. Hall: Photobiology for food, fuel and fibre—II
- Sir Cyril Clarke: Wrong ways to choose right medics?—III
- H. H. Lamb: Climate—problem of recent changes—IV
- B. J. Mason: Climate—forecast uncertain—IV

- Sir Alastair Pilkington: Floating to success on glass—VI
- Andrew Belsey: Is Hannes Alfvén's view myth or history?—VII
- J. C. Polkynghorne: Potshots at research puddings—VII
- Magnus Pyke: BA news—VIII



# Photobiology for food fuel and fibre

by D. O. Hall

Light activates chlorophyll (photosynthesis), the retina (vision), DNA (mutations), phytochromes (day-length control), the eye and hypothalamus (orientation and navigation in animals), the skin (tanning and cancer), and a number of other similarly important reactions in biology. In this article I want to try to outline the possibilities that photobiological energy conversion might have in providing food, fuel and fibre in the future—this is a recently revived concept of an old process, namely photosynthesis.

Since the change in oil prices three years ago there has been a renewed interest in solar energy systems as one of the alternative mechanisms for providing energy now and in the long term. Solar energy also encompasses the idea of using biological systems to capture the solar energy in a stored form (reference 1).

One of the important things that plants are able to do is to collect diffuse solar radiation and store it for later use. We know that solar energy is ubiquitous and occurs universally to varying extents throughout the world. But the problem is capturing it and storing it in a usable form.

Plants solved this problem via the mechanism of photosynthesis when they developed the process about 3,000 million years ago. It seems time that we re-examine how plants do it, try to improve plant efficiencies and even try to emulate plant photosynthetic systems.

The unique capability that plant systems have is to harvest light using their chlorophyll-containing membranes (normally found in chloroplasts—see figure 1) in order to split water into its component parts, oxygen and protons (hydrogen). Normally the plant uses the protons and high-energy electrons produced in the light reactions to reduce (fix) CO<sub>2</sub> to the level of carbohydrates (figure 2).

This is a key reaction to life as we know it, additionally since the oxygen is a by-product of water splitting. The carbon dioxide is fixed in the form of organic

compounds as diverse as carbohydrates, fatty acids and proteins (and many other organic compounds). I do not wish to go into the mechanism of photosynthesis but one can consult numerous books on the subject (reference 2).

The theoretical efficiency of photosynthesis in red light is 33 per cent but crops grown with good agriculture in temperate zones have efficiencies between 0.5 and 1 per cent (fixed carbon energy compared with total light energy available) and in tropical areas between 0.5 and 2 per cent. However, over the whole earth the efficiency of photosynthesis is only 0.1 per cent. Even with this efficiency the amount of carbon fixed every year into stored energy is ten times the world's use of energy in 1970.

Of this fixed energy only 0.5 per cent is consumed by our present world population. Thus one can see that vast amounts of energy are available in a fixed form and there is an excess of food available. The problem is that the distribution of this plant material is not generally where it is required in the energy-consuming temperate countries, or in the food-consuming warmer countries where there is an excess population.

The aim of this article is to show that there are distinct possibilities in using photosynthesis in its natural state or possibly even in an artificial state in order to harvest food, fuel and fibre. One of the important things that has happened in the past few years is that people have looked at the process of photosynthesis in a new light in order to see if it cannot be adapted or manipulated into modern requirements in the world.

The simplest concept is probably energy plantations or energy farming, for example, growing specific crops for their energy content. In the past this would have been considered as harvesting wood and burning it; the ideas now are more as an integrated harvesting of crops for both food and fuel, the fuel component coming from the by-product of crops, for example maize, might be harvested for its corn and the rest of the plant fermented to methane or alcohol.

Alternatively, serious consideration is being given especially in the United States and Australia to selecting or adapting specific crops for their photosynthetic efficiency, and other attributes, which would make energy farming economical. For example, in Australia they have identified five crops—eucalyptus trees, hibiscus shrubs, Napier grass (a tropical fodder grass), sugarcane, and cassava (the West African root plant)—as most suited to energy farming. The products from these farms would be fermented, or pyrolysed (that is heat degradation at 600 degrees) to products like solid char, oil, alcohols and gases.

Studies have shown at present the fermenting of cassava (which contains 80 per cent starch) to alcohol, is competitive with industrial alcohol. The four other

crops produce fuels which are two to four times more expensive than conventional fuels. The problem with these crops is that the woody material has to be first degraded by an expensive milling process before it can be fermented by a biological system. This may be overcome by recently discovered enzymatic techniques in Sweden which break down the ligno-cellulose cell walls before a further enzymatic fermentation.

In the United States one group has identified fast growing poplar trees which regenerate from stumps as a suitable crop to use for energy farming. In these cases the land which is not suitable for conventional agriculture is used to grow the energy crop. There are many kinds of economic restraints on these systems, the most important of which, besides milling processes, is the amount of transport which has to be used to get the material to the processing plants.

The economics of energy farming systems have been worked out quite in some detail and the concept of using biomass is now receiving very serious attention, especially in the United States. In Europe there is an EEC-sponsored programme which is looking at the possibility of growing energy crops in Ireland on peat bogs—here the growing of such crops is especially favourable since the area would provide renewable energy resources rather than the once-and-for-all harvesting of peat. Other programmes are being looked at in France, Denmark, Germany and the United Kingdom for the use of waste material, such as straw, for the provision of fuel or for its use as food by cattle.

One of the usual questions asked is the availability of land areas. We obviously do not want to utilize valuable agricultural land (unless food and energy production are integrated), but we do want to use marginal land and forest areas which up until now have not been utilized to their full extent; for instance, in the United Kingdom only 29 per cent of the land is used for arable farming. In Scotland vast areas could be afforded rather than left to heather which itself is a result of over-grazing of the Highlands which used to be very densely forested.

I have dealt in some detail with one aspect of photobiological energy conversion and will now mention others which are being actively investigated around the world to see if they have both short and long term practical applications.

The extraction of loaf protein from suitable crops can yield two to three tonnes of protein per hectare per annum to provide human or animal food. About 10<sup>11</sup> tonnes of cellulose are produced by plants each year making it probably the most abundant organic material on earth.

Since cellulose consists of long chains of glucose molecules it is considered a good starting material for the synthesis of alcohols, other chemicals and fibres.

Waste materials (organic) are a plentiful medium for the growth of algae in a mixed culture fermentative bacteria. The algae harvested for their food and/or content—simultaneously waste and waste disposed of in a useful way.

Greenhouses are being redesigned for the large-scale growth of plants under conditions which economically use energy and allow optimum growth marked contrast to presently used houses.

Physiological adaptation of plants to future possibility in light of a recognized metabolic characteristic of plants, C<sub>4</sub> photosynthesis has been found to be a characteristic of certain crops such as maize and sugar cane. This type of photosynthesis has four C<sub>4</sub> compound formed has four C<sub>4</sub> instead of three, as in wheat and C<sub>3</sub> photosynthesis has distinct advantages in that these plants can use a wide range of light intensities, have lower requirements, and can use low concentrations of CO<sub>2</sub> (often a limiting factor in the atmosphere).

A further most important change is that they lack photorespiration process whereby up to 50 per cent of photosynthetically fixed CO<sub>2</sub> is lost to the atmosphere in a light-activated reaction. Much basic and applied research is now going on to see if it is possible to inhibit photorespiration and plant yields. CO<sub>2</sub> enrichment in atmosphere increases plant yields by inhibiting photorespiration and also increasing N<sub>2</sub> fixation.

The recently recognized process of N<sub>2</sub> fixation has shown that the photosynthetic material passing leaves to the roots is the limiting factor in the process and not the activity of N-fixing bacteria in the roots. The covering of associative symbiotic fixation in roots of maize, wheat and also opened up many new possibilities of eliminating nitrogen requirements in crops. The manipulation of N<sub>2</sub> fixing bacteria plants also has an exciting future.

Artificial photosynthetic systems mimic natural photosynthesis in a way which is now being looked at in a new way. Again this type of research stimulated by the realization that the world will run out of liquid and gaseous fuels in the beginning of the next century and that photosynthetic process provide a means of artificially by plant systems.

Work is being done on the production of H<sub>2</sub> gas from the splitting of water using chlorophyll membranes and hydrogenase enzymes from *Rhodospirillum rubrum* (Figure 3), generation of electricity from photoelectrochemical reactions—chlorophyll layers, or purple membranes from *Haloferax volcanii*—a salt-loving bacterium with very stable membranes.

These purple membranes may possibly be used for desalination since they exchange H<sup>+</sup> (generated in the light) with Na<sup>+</sup> and K<sup>+</sup>. It may be possible to mimic CO<sub>2</sub> fixation in a chemical way—the plant enzyme performs this very well, so chemists are now trying to do it in the test tube.

In conclusion, the process of photosynthesis might in the future provide us with much more food, fuel and fibre than has been thought previously. The very adaptable organisms which have survived the energy crisis 3,000-million years when the blue-green algae learned to use light and split water. It seems that we studied these phenomena with much greater determination in order to either improve the efficiency of or actually to emulate plants in their systems. By selection or chemical genetic manipulation of plants we may be able to improve the efficiency of photosynthesis and thus utilize our cultural systems to produce the carbon and energy requirements of the future (references 3 and 4).

The author is professor of biology department of plant sciences, King's College London.

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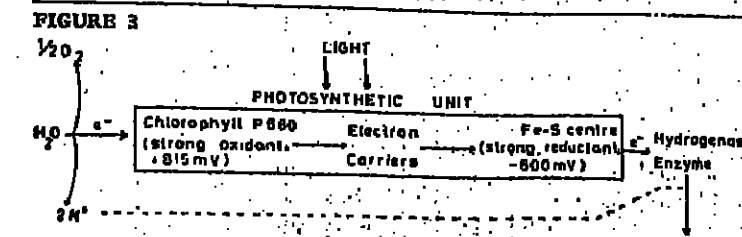


FIGURE 3 Coupling of solar energy to H<sub>2</sub> production using stabilised chloroplast membranes plus hydrogenase enzymes.

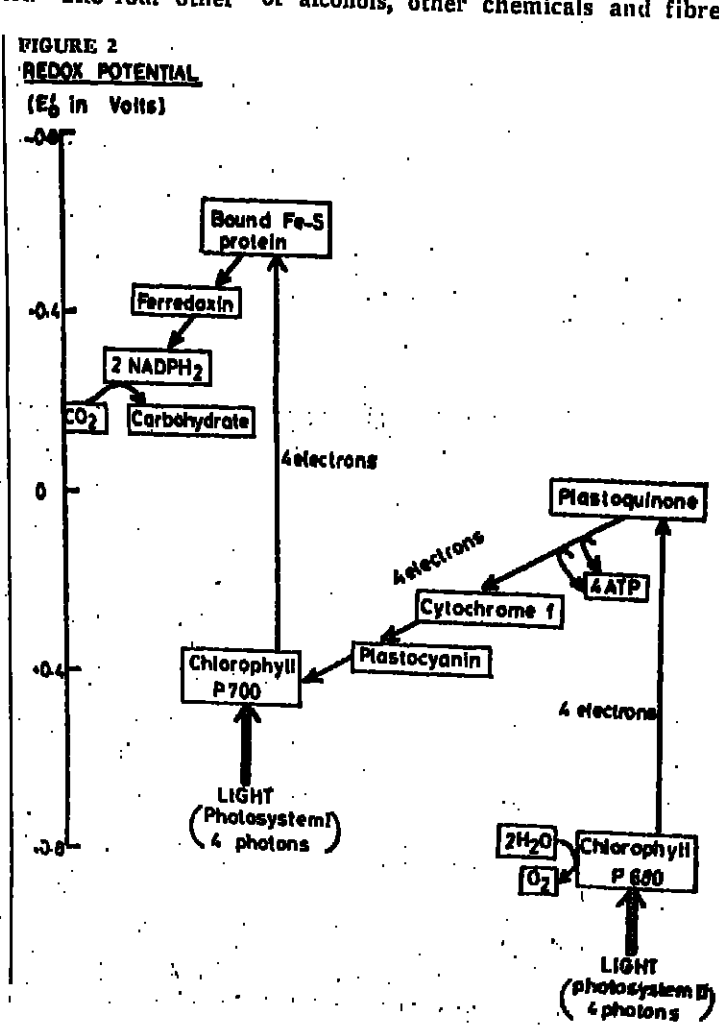


FIGURE 2 REDOX POTENTIAL (E<sub>0</sub> in Volts)

# Wrong ways to choose right medics

by C. A. Clarke

Doctors who actually treat patients know that diagnoses are not infrequently wrong and that, even when right and the outcome of an illness favourable, there may well have been uncertainties on the way.

In other words, we are used to being in difficulties and it comes as no surprise that answers to questions about training "the right number and the right type" of doctor may be erroneous—simply because, as with a difficult bedside problem, so many factors are unknown. The solutions are in parallel, we obtain other advice (particularly from clinicians), we edge into the future with a tentative plan that can be modified at very short notice, and if it is a community dilemma we can carry out pilot studies. And at all costs we must not fuss.

Academic attainments, in practice the results of three A levels, are probably the best criteria for admission to medical schools (though there should be no hesitation about making some exceptions) and at present there is no lack of applicants. The trend of the young remains anti-science (though there are signs that this is altering) and furthermore, school-leavers, via their GPs and the media, now realize that medicine is an exciting subject and see it as a career for their best students. Headmasters' reports and where possible interviews remain most valuable adjuncts to assessment.

Is any particular social or family background desirable? Probably not. Variety is to be desired, and given the wish to qualify as a doctor, and the necessary A levels, anyone can make a go of it. More specifically, should doctors' offspring be encouraged to follow in father's footsteps? Certainly it helps a student if a parent knows the ropes—but does it help the patients?

To my mind, because fleshpots are in the ascendant, I would plump for the parson's child—public-spirited, well-disciplined and accustomed to relative poverty. Generalizations, however, are dangerous, and statements such as "the social composition of medical students biases them against working in under-doctored areas" simply do not square with the view that the young are more sensitive to the needs of their fellow-men, more aware of the major imperfections of society and more concerned to take responsibility for the wider social obligations of medicine than they were a generation ago.

Nor does this in its turn tally with the observation that juniors are now principally concerned with financial gains and, to enforce their demands, are capable of unthinkable things like working to contract and endorsing the policies of overtuers.

So, for the "right type", *quot homines, sic aeternitates*, but overall, when one comes to consider an individual, suitability is not hard to assess. "How many?" is far more difficult, but with the uncertainties (as opposed to the unknowables) we can assess odds. Thus it seems likely that the country will remain in economic disarray for some years, that the shortage specialists, such as geriatrics, will remain so, and that more doctors will want to live in the south-east corner of the country than in the industrial north. If these are correct, we should not bank on much NHS growth, we must endeavour to make do with what we have got and if social justice is to be done there must be some redistribution of our resources.

Uncertainties can be tackled gradually, but unknowables may require sudden changes of direction. Thus, first it is government policy to increase the output from British medical schools so that we are no longer dependent on overseas doctors. This source of manpower would in any case probably have dried up, partly because foreign governments look at their graduates in the way we do our own, and partly because of the high failure rate in the examination (TRAB) to test language and competence.

Whatever the outcome with the foreign doctors, where are the careers for our



European medicine: "something of a madhouse".

additional young people in a health service where consultant and GP expansion is limited by lack of money? Most of them, we hope, will want to remain here, and we certainly want to keep them. But will there be jobs? We must not run into a schoolteacher situation.

Second, it is DISS policy to encourage women to continue in medicine, and to enable them to do this after marriage no part of postgraduate medical education need be full time. But how many of the thousand or more women who qualify each year will want to fall in with this?

Third, and most important, now that there is free movement in the EEC countries how much migration of doctors will there be? Theoretically, it sounds like a godsend for the possible unemployed, but strangely, other countries have similar problems.

Finland, Denmark and Sweden are all over-producing English-speaking doctors and they might come here. It is said that the Germans are hoping that British immigrants will fill the gaps when their overseas doctors leave. Truly, European medicine is something of a madhouse, and we must be vigilant, not year by year, but month by month.

Surely a solution to our NHS problems should be child's play to a nation which has won two major wars within my lifetime? The key to the unknowable trends (career posts, women doctors and the EEC) lies in having a sensitive regulator and this is the number admitted to medical schools.

The planned increase is from 3,276 in 1973 to 3,945 in 1980. Since there are 26 medical schools a reduction of only a few per annum for each of them would reduce the "bulge" later on, and hardship could be minimized if promises to applicants were kept and the reduction only made in the subsequent year. But the regulatory mechanism must keep abreast of altering situations and these are far too urgent to await the report of the Royal Commission.

To cope with the possible bulge, we should copy Europe, where there is a "specialist" career grade which is not the equivalent of our consultant (many of them are not on the staff of a hospital) and yet requires training and the gaining of a certificate in the chosen discipline.

If "specialists" were a solution to the bulge problem, what could be done to increase the efficiency of both consultant and GP so that an increase in their numbers is minimized, bearing in mind that the economic climate is likely to remain bleak for much growth?

Health education might help here by trying to halve the number of patients rather than doubling the doctors. So they could be supernumerary and trained for a year or so under the specialists before they went home. The consultants would continue in the same numbers as they are at present and there could be promotion from the specialist ranks. A howl of rage always goes up at the suggestion of making any sort of sub-consultant grade, but there are careers below the headmaster, and the specialist system would be particularly useful for part-time doctors, male or female.

If the bulge comes about, the new grade would be worth a trial, perhaps by a pilot scheme in one region for one or two specialties. The salary should be between that of a senior registrar and a consultant, and I would favour specialists being eligible at least for the lower ranges of distinction awards.

But people who actually look after patients should be fully consulted about new policies. It will be clear from what has been written that no one knows the answers to our problems and therefore it is essential that we are alert to the possibility of a rapid change of direction if the evidence suggests that this is necessary. Moreover, we should not be afraid to experiment. But people who actually look after patients should be fully consulted about new policies.

Sir Cyril Clarke is President of the Royal College of Physicians and presided over a symposium on medical aspects of space surgery at the 1976 annual meeting of the British Association.



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# Climatology 1 Need to make up for lost time

by H. H. Lamb

Not long ago, it was generally taken for granted that climate—as distinct from the day-by-day changes of weather and the obvious differences of one year from the next—was essentially constant. Accordingly, tables of climatic statistics of the weather observations of any run of 20 or 30 years should constitute a sound basis for planning decisions in agriculture and forestry, town and country planning, fuel and water supply and so on, provided only that the instruments were maintained to the highest standards and exposed in a standard manner.

Now, however, attitudes to climate and climatology, to what can properly be expected of this branch of science and how it should proceed, are changing. A remarkable sequence of extremes of one kind and another has occurred since 1960. To consider the British Isles alone these include: in 1962-63 the coldest winter since 1740; in 1963-64 the driest winter since 1743; in 1968 and 1969 on at least four occasions 24 to 48-hour rainfalls in the lowland districts which exceeded the once in 50 years expectation; in 1974-75 the mildest winter in England since 1834; the great gale of January 2, 1976, perhaps the severest since 1703; and for 16 months to August 1976, a drought surpassing anything reported in the available rain-gauge records since 1727, as well as in the summer of 1976 a 24-day period warmer by about 4°C than any calendar month in the 300-year temperature record for central England.

Comparable extremes have been reported from other parts of the world, the most serious being the droughts in the Sahel-Ethiopia and that which produced harvest failures in India and the USSR. The impact of these extremes on harvest yields, trade, and the insurance and other industries and ultimately on governments, has produced an increasing demand for advice on the future develop-

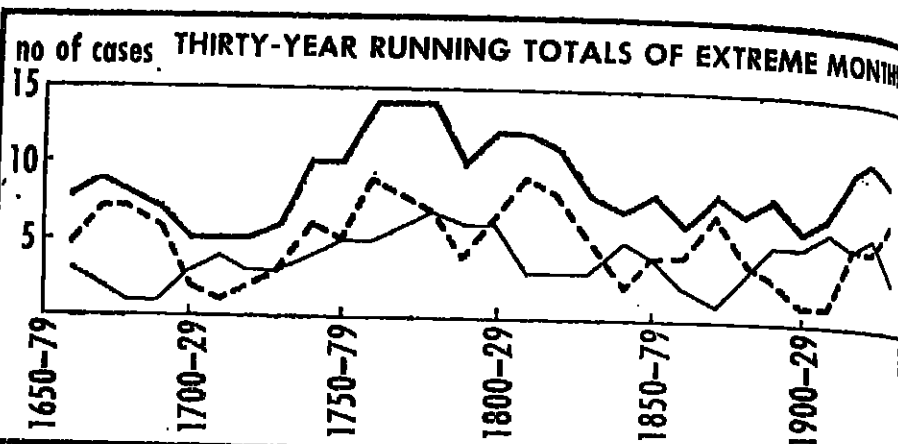
ment of climate for which the science was in no way prepared. Over about the same period, the aspect of meteorology and the potential of climatology have been transformed by the computer revolution. Yet it is important to arrive at a realistic assessment of just how the capacity of the science has been changed, as well as how far the development can reasonably be expected to go. No less needed is a careful assessment of what those whose planning is vulnerable to climate could, or should, do in response to such guidance on future climate as may become available.

The most obvious need is for greater knowledge of the behaviour of climate, of what has happened, and what can happen, on every time-scale from the year-to-year (and shorter) variations to the long-term processes of climate, which also involve some phases in which the rate of change is rapid. Identification of the physical causes of climatic changes, and the mechanisms—the heat transports in the atmosphere and oceans, and the energy stored in them, fluctuations of the solar energy available and tidal forces and so on—and their characteristic time-scales observed during many instances of each evolution, is needed. And the picture is now further complicated by the increasing scale and possible impacts of man's activities. (So far, the only convincingly demonstrated effects are the warming of cities and industrial areas and the tendency of the increasing carbon dioxide in the atmosphere to warm the Earth or to moderate any tendency towards cooling.)

It is hardly surprising that during the long period when climate was assumed to be constant little research was devoted to surveying the actual long-term record of climate behaviour. There is now much need to make up for lost time. The assumption of constancy seems to have been a premature conclusion from the first available 100-year records of meteorological instrument observations in the leading cities of Europe and eastern North America. Many of these records had actually been started because of widespread alarm in the later part of the eighteenth century about the increased incidence of extremes of weather evident at that time.

Figure 1 shows the numbers of abnormally hot summer and cold winter months prevailing in central England since 1660. Notice that the period between about 1740 and 1830 had a high incidence of these extremes, to which our own times provide one of the nearest comparisons. The simplest interpretation of such variations is in terms of the large-scale

FIGURE 1  
no of cases THIRTY-YEAR RUNNING TOTALS OF EXTREME MONTHS



Numbers of extremely warm (over 17.5°C average temperature—thin line) and extremely cold (below 0.5°C—broken line) months occurring each 30 years since 1650 in England. (Bold line—combined total of both extremes.)

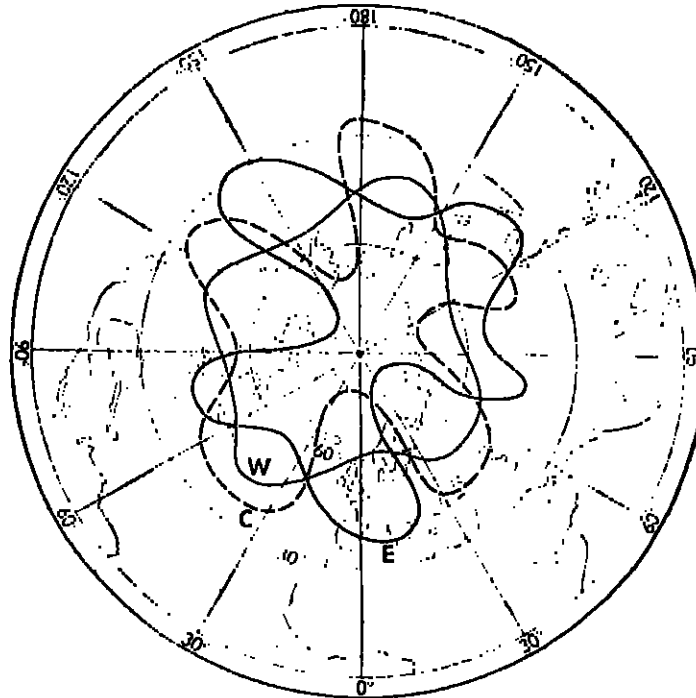
circulation of the atmosphere, most simply of all in the patterns and strength of the circumpolar vortex of upper westerly winds over either hemisphere. This is the main flow of the atmosphere, prevailing through a deep layer from about two to 20 km above the Earth's surface.

It is set in motion by the expansion of the air columns, which lifts all the upper layers over the warmest zones of the Earth, and the deviation of the resulting poleward thrust of these layers as the Earth rotates beneath. The strongest flow, being generated by the temperature gradient, is over middle latitudes, varying seasonally in strength and migrating a few degrees poleward or equatorward. Superimposed on this seasonal variation are some geographical anomalies, produced by land, sea and ice, as well as shorter and longer-term variations. Understanding the implied changes in the energy-feed is vital to the development of any capacity for forecasting more than a few days ahead.

We find that from periods of weeks to many years the flow of the upper winds is characteristically flow-line marked W in Figure 2)—described as a well-developed displays large-amplitude meanders, with pronounced southerly and northerly components over different longitudes. These "meridional" excursions of the flow lie in different longitudinal sectors on different occasions (e.g. the lines marked C and E in Figure 2). At times of zonal circulation surface low-pressure systems (depressions) are continually steered from west to east

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FIGURE 2



Flow of the "upper westerly winds" (line near the axis of strongest flow), W—Westerly or "zonal" type, C and E—meridional positions of "blocking" pattern.

which have also affected the Indian monsoon and the Soviet grainlands in central Asia with dire effects on the world's food reserves in recent years. There was a global rise of about 0.5°C from the 1880s to the 1940s and a decline since, which has flattened off but seems not to have been reversed in spite of the mild winters and hot summers in Europe in the last few years.

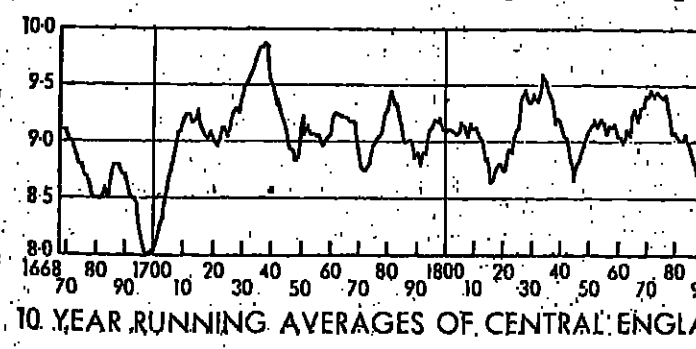
The changes in the Arctic have been of greater magnitude. Surveys (from meteorological satellite observations) of the total extent of ice and snow over the northern hemisphere at frequent intervals indicate that this has increased since the 1960s; and other, more fragmentary, evidence suggests that the minimum of the Arctic sea ice was as early as the 1940s. The cooling of at least the northern hemisphere, and especially the Arctic, since 1950 has been accompanied by a marked decline of the westerlies (increase of blocking) over middle latitudes.

It may be that there is a correlation between periods of global cooling and increase of blocking, which would also mean that such periods should be expected to produce short-term extremes of warmth as well as cold. The English temperature record shows that there were some impressive heat waves (the summers of 1665 and 1666 which "produced" the Great Plague and Fire of London) at the height of the cold-climate period of recent centuries known as the Little Ice Age. The geography of abnormal warmth and cold in the summer of 1976 (Figure 3) may also support the same interpretation.

The variations of rainfall seem explicable in terms of variations of wind transport of moisture from the oceans and of cyclonic or anticyclonic development over the regions of interest. It is uncertain how far the precipitation may also be influenced by variations in the abundance of various kinds of nuclei for condensation of the water vapour in the atmosphere.

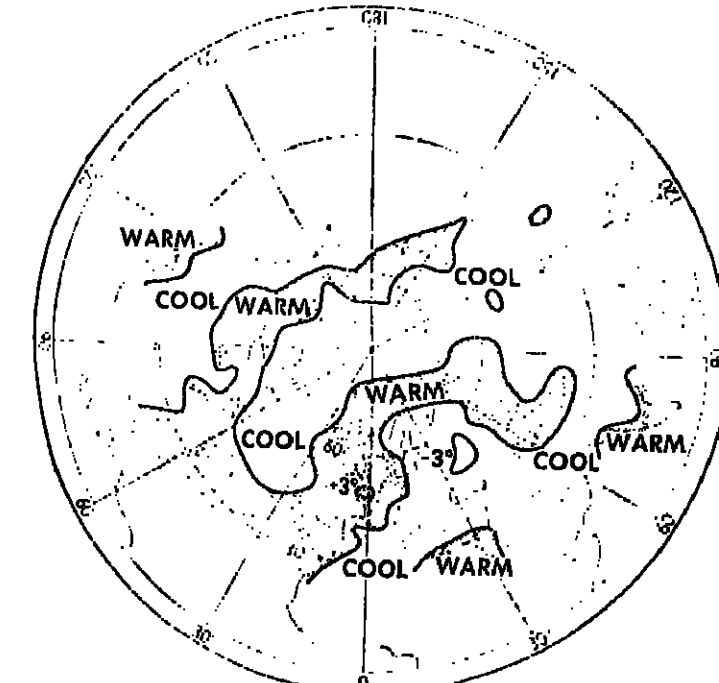
These interpretations are a long step forward from the state of knowledge and practice only twenty years ago but they fall far short of constituting a forecasting system. Research towards this end is a plainly urgent and needs to be pursued along at least three lines:

- Reconstruction of the longest possible past record of climate (and wind and ocean circulation characteristics) over as much of the world and in as much detail as observational evidence and "fossil" data permit.
- Theoretical modelling, using the fullest global observation coverage of the present day, should elucidate the effects of every kind of change in the external conditions upon the atmosphere and oceans and the feedbacks and teleconnections whereby one part of the global atmospheric circulation influences another.
- Identification of whatever kinds of (a) man-made pollution, and (b) geophysical and extraterrestrial phenomena may influence the Earth's atmosphere and climate, as well as physical linkages between cause and effect, and the geogra-



10-YEAR RUNNING AVERAGES OF CENTRAL ENGLAND TEMPERATURES

FIGURE 3



Areas with warm (shaded) and cool summer in 1976 and 1975 and in bold black outline where the average was over 3°C above or below the long-term mean.

phical ranges and timing of the results. The leading official meteorological services with their giant computers are best equipped to pursue the second and third (a) items and seem generally to be concentrating on them. The first item poses the most broadly interdisciplinary problem in all science: for contribution to reconstructing the past record of climate come from fields as diverse as studies of classical antiquity and ancient scripts, measurement of stable and unstable isotopes, and biological specimens in the skeletal remains of micro-fauna in the ocean bed.

Such work is best done in a university environment and in bodies such as the climatic research unit at Norwich. Similarly, the third (b) item is covered by a variety of geophysical and astrophysical institutes in universities and elsewhere. No one of these lines is likely to give adequate results on its own. Indeed any such pretensions, from whatever quarter they come, can only be deplored. It is important that arrangements such as conferences and projects for joint research should continually be made to ensure the necessary intercommunication between these very different fields of study and the people engaged in them.

It happens that research under the second and third (a) headings, with by far the greatest cost, is so far the only side endowed with official funding. This may be understandable in relation to the supposed threat of a drastic global climatic change within the next 50 to 100 years resulting from the increasing scale of man's energy production and its by-products, the subject of a solemn warning issued by the World Meteorological Organization in June 1976.

But it fosters the illusion that significant climatic changes are only liable to be produced by man's activities and that theoretical modelling of the processes of climatic fluctuations and changes can usefully be pursued without knowledge of the past behaviour of climate.

Knowledge of the past record of climate is needed to test the theoretical models' ability to explain it, and to identify processes which cause cyclical recurrences of specific climate tendencies at intervals ranging from decades to centuries and millennia. It is only from adequate knowledge and assessment of the regularity of the latter that it will be possible to estimate the probabilities and margins of error that should be attached to any forecast of future climate.

The author is director, climatic research unit, University of East Anglia, Norwich, and honorary professor in the university.

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# Climatology 2 Immediate forecast: uncertain

by B. J. Mason

Weather and climate play such a vital role in human life and affairs that the possibility of any marked change, whether natural or man-made, is bound to cause concern. While we may discount the sensational and irresponsible warnings of imminent climatic catastrophe, whether by the rapid onset of a new ice age or a major warming, it is important to realize that climatic fluctuations, which occur on all time scales ranging from years to millennia, are likely to have a greater economic and social impact in the future than in the past.

Increasing world population and a desire to raise living standards have increased the pressure on natural resources of food, water and energy, the balance between the supply and demand for which could be seriously affected by only rather marginal changes in climate. Essential for understanding and evaluating these changes is a coherent and consistent reconstruction of the Earth's climatic history, but despite the recent advances in paleoclimatic-dating techniques there are still many gaps in the record. Instrumental records go back for only about 300 years; one of the most reliable is Manley's temperature record for Central England dating back to 1668

(graph). This and similar records are so dominated by irregular fluctuations and abrupt reversals, with few, if any, regular features, that they hold little promise of predicting future events by the extrapolation of existing trends.

The most prominent feature of the graph, present also in the record of annual mean temperatures for the whole northern hemisphere, is the upward trend of temperature beginning about 1880 and continuing until 1940. This trend was reversed between 1940 and 1970 with mean temperatures drifting about half-way back to the 1880 levels.

Apart from the dubious of making a forecast from such a highly fluctuating record by extrapolation of such a short-understand, especially when we do not understand the causes of such changes, there is now evidence that the cooling trend has been arrested. Since 1970 the lower atmosphere in the Arctic basin has warmed by about 0.2 degrees C and there has been a marked reduction in land snow cover and in sea ice, and stronger westerly winds with less frequent outbreaks of northerly winds leading to a succession of five mild winters in Europe.

Recent disasters such as the drought in the Sahel region of Africa, far from being unprecedented, have parallels in the past. Although wet and dry spells tend to occur in anomalous groups of years they do not occur at regular predictable intervals. The droughts from 1970 to 1974 (the rainfall has since recovered) have been attributed to a change in the global atmospheric circulation leading to a southward shift of the major climatic zones, including the Sahel desert; but, in fact, the situation is not as simple as that because during this five-year period, the sub-tropical high-pressure belt actually moved slightly northwards.

Our recent severe drought also came at the end of a five-year dry spell in which the average annual rainfall over England and Wales was only 826mm, compared with the long-term average of 910mm—the lowest five-year mean value since 1850. However, since 1825 there have been six five-year periods with average falls of less than 840mm, suggesting that we can expect a five-year dry period to occur about once in 25 years. However, in the 16-month period May 1975-August 1976 the rainfall totalled only 760mm, the lowest value since 1727 when records began. Such an unusual event may be expected to occur once in 500 years.

These rainfall anomalies were closely linked to changes in the atmospheric circulation over the northern hemisphere, during which the mean position of the Atlantic-European sector of the jet stream gradually moved almost 1,000 miles north-westwards from its normal location to lie between Iceland and Scotland, and caused the centres of the major depressions to move well north of the British Isles. This was also accompanied by a marked recession of the Arctic ice. Although these anomalies had dramatic consequences for the British Isles, they were quite small when viewed on a global scale and were probably the result of only rather minor fluctuations or readjustments in the large-scale atmospheric circulation elsewhere. Neither the European nor the Sahel drought, both of which have since been followed by heavy rains, suggest global patterns of climate but are expressions of its variability. Unfortunately there is no physical basis for predicting either the timing or magnitude of such fluctuations.

The main barrier to complete description, understanding and prediction of weather and climate lies in the immense complexity of the atmosphere in which radiative, dynamical and hydrological processes interact non-linearly on all scales ranging from millimetres to thousands of kilometres. The result is a complex system, unstable for motions of certain

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The main barrier to complete description, understanding and prediction of weather and climate lies in the immense complexity of the atmosphere in which radiative, dynamical and hydrological processes interact non-linearly on all scales ranging from millimetres to thousands of kilometres. The result is a complex system, unstable for motions of certain

scales but relatively stable for other controlled by competition between positive and negative feedback processes within boundaries prescribed by its dimensions, geography and rate of rotation of the Earth, the sun's radiation and the thermo-dynamic properties of the atmospheric gases.

The interaction of so many processes acting on different space and time scales makes it almost impossible to distinguish cause from effect and unsafe to infer direct causal relationships even between apparently closely connected events. Together with the cumulative influence of random disturbances too small to be observed, sets ultimate limits to the accuracy with which atmospheric events may be predicted.

By far the most promising approach to the understanding and prediction of weather and climate lies in the development of complex computer models designed to simulate the atmosphere as a turbulent rotating fluid heated by the sun and exchanging heat, moisture and momentum with the Earth's surface and the oceans. Since the most powerful computers capable of executing more than ten million arithmetical operations per second are inadequate for the task even the most sophisticated models, such as those devised in the Meteorological Office, are much simplified representations of the real atmosphere.

Nevertheless, within less than 100 days of starting from a motionless, constant temperature atmosphere containing the major features of the present climate, including the global wind systems, pressure, temperature and rainfall patterns, and seasonal changes such as the monsoon. Although they are not capable of predicting future climatic changes they are able to give some indication of the likely climatic effects of fairly large changes in such factors as

the sun's radiation, the carbon-dioxide and dust content of the atmosphere, vegetation, ice and snow cover, sea-surface temperature and the artificial release of large quantities of heat and moisture. Several model calculations of this type have been recently carried out in the Meteorological Office.

Simple heat-balance calculations indicate that a 1 per cent increase in the sun's radiation would produce an average rise of about 0.7°C in the temperature at the Earth's surface. The fact that the sun's output does not appear to change by as much as 1 per cent probably accounts for the failure to find strong correlations between the weather and the sunspot cycle.

Changes in sea-surface temperature undoubtedly affect the atmospheric circulation. During the winter of 1962-63, the coldest in Britain for 250 years, a large area of the eastern tropical Atlantic Ocean was up to 2.5°C warmer than normal. When this anomaly was inserted into the model it produced an area of low surface pressure centred in the Bay of Biscay and a large area of high pressure centred just east of Greenland. The modified circulation resulted in strong easterly winds over the British Isles very similar to those that caused the cold winter of 1962-63.

The concentration of carbon-dioxide in the atmosphere has increased by 10 per cent during this century due to the burning of fossil fuels. Model calculations indicate that this should have warmed the lower atmosphere by an average of 0.3°C. The fact that, even so, temperatures in the northern hemisphere actually fell by about 0.6°C between 1940 and 1970 has been attributed to a simultaneous increase in the dust in the atmosphere.

It is true that the atmospheric turbidity even at remote sites increased markedly after 1963, but this was almost certainly caused by a large volcanic explosion in Bali and now, with measurements almost back to pre-1963 values, there is little evidence that the dust content is increasing significantly. Following the Bali eruption temperatures in the lower stratosphere rose by several degrees but there were no detectable effects at ground level.

This observation is consistent with the results obtained from our model, when a stratospheric layer of dust, sufficient to intercept 4 per cent of the incoming solar radiation, was inserted. This produced local heating of up to 10°C due to absorption of the radiation by the dust, but there were no discernible effects at ground level. This hardly supports the thesis that cooler epochs in the historical record may have been caused by volcanic eruptions.

The same model was used to investigate the likely effects of reducing the concentration of the stratospheric ozone layer by 50 per cent. This produced a cooling of up to 20°C at 40km altitude over the tropics but again insignificant changes in the lower atmosphere. Since we calculate that several hundred Concordes each flying five hours per day would not reduce the ozone by more than 0.5 per cent (US scientists have estimated about 1 per cent), and such a small reduction could not be distinguished from the much larger natural fluctuations, supersonic transport aircraft are unlikely to have a significant effect on the climate during this century.

US scientists have recently suggested that chlorofluorocarbon compounds, commonly known as Freons, when released into the atmosphere from aerosol cans and refrigerators will be carried up into the stratosphere and there be decomposed by ultra-violet radiation to produce free chlorine atoms that will combine with and destroy the ozone molecules. Calculations based on very simplified models of the air motion suggest that if the production of Freons was held at the current rate their stratospheric concentration would reach a steady value at about 10 times the present level by the year 2100 and reduce the ozone by about 8 per cent.

However, because the ozone cycle involves many chemical species and reactions, whose concentrations and rates are uncertain, the results of these calculations may well be in error by factors of three to five and much more research is required to establish the potential threat of Freons relative to that of other possible mechanisms of ozone depletion. But, whatever may be the harmful medical effects of an accompanying increase in ultra-violet radiation, we can be reasonably confident that the effects on the climate will be negligible and undetectable.

However, in general, the results of model computations should be regarded as indicative rather than definitive because the models still have important deficiencies. In particular they do not properly treat interactions between the atmosphere and the oceans which, I suspect, hold vital clues to the understanding of climatic changes.

Reliable predictions of such changes will require not only improved models but much greater scientific effort and computer resources for their testing and evaluation and may not be possible for several years.

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## Floating to success on glass

by Alastair Pilkington

It is 20 years since the world's first production scale float glass plant was started up by Pilkington in St Helens. For its first 14 months it made no saleable glass, the monthly operating bill was £100,000 at a time when the company's profits were declining, and there was simultaneously a continuing struggle to secure patent rights in the United States. In 1957 the development team had to face objectively the prospect of failure after five years' intensive work.

Today there are 55 plants around the world using the Pilkington process for forming high quality glass by floating it on a bath of molten tin. These float plants represent an investment of well over £1,000m at today's money values and have a combined annual capacity of nine million tonnes of glass, most of which is supplied to transport and building industries. Licensing income from these plants is currently running at £25m a year.

There are several lessons to be drawn from this change in fortune, not least that a development man must remain an optimist. Clear, too, is the fact that big projects involve big risks and big expenditure without any guarantee of success; and that the risks should be taken only if there is a high probability that success will bring large rewards, both to recoup development costs and to fund exploitation of the innovation—and indeed of further innovation.

That in turn calls for success to be clearly defined at the beginning of a project.

In the case of float, success would be not simply to produce glass by floating it on a bath of molten metal. That was accomplished quickly enough. We would in fact be successful only if we replaced the existing polished plate glass process which was established world-wide as the sole method of making high quality flat glass.

Polished plate glass was used for car windscreens, mirrors and windows, where its distortion-free characteristic was necessary. It was made by a process whose basic principles had remained unaltered for more than 250 years. Essentially, glass was melted, a ribbon was cast and rolled flat, and its surfaces, marked by contact with the forming rollers, were ground and polished to make a high quality, distortion-free transparent product.

Much development work, concentrated largely between the 1920s and 1950s, had led to a highly mechanized and successful process which Pilkington licensed to most of the world's major flat glass producers. In its ultimate form, a continuous ribbon of glass was rolled from the melting tank and passed through an annealing lehr.

The ribbon, still in continuous form, was then ground on both surfaces at the same time with enormous grinding wheels fed with progressively finer sand. This machine, called the twin grinder, was driven by 1.5 Mw and this power was expended in grinding a slender ribbon of brittle material. Even more remarkable was the fact that the bottom grinding wheels were kept perfectly flat and level while they were wearing away.

While making a first-rate product, however, it had the drawbacks of very high capital and operating costs together with glass wastage of 20 per cent from the grinding process. Success with float would be to make as good a product as plate and to eliminate grinding and polishing.

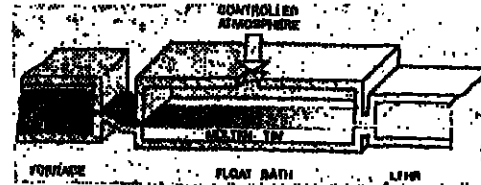
Today float has virtually superseded the polished plate process throughout the world and, as was hoped at the beginning of development work in 1952, is taking over a considerable amount of the market previously supplied by the sheet glass process—the flat glass process that has traditionally met most of the demand for cheaper domestic and horticultural glass.

Float glass has thus not only matched the high quality of plate but also the relatively low price of sheet—and with the bonus of better quality. Float, in fact, now supplies about 40 per cent



A continuous ribbon of float glass leaves the annealing lehr having been cooled down in controlled stages on its way to the automatic warehouse.

Right—diagram of the float glass process.



the Western world's clear flat glass demand.

In the process a continuous ribbon of glass moves out of a melting furnace—typically holding 1,700 tonnes of glass—and processing 3,000 tonnes a week—and floats along the surface of an enclosed bath of molten tin. The ribbon is held in a chemically controlled atmosphere at a high enough temperature for a long enough time for the irregularities to melt out and for the surfaces to become flat and parallel.

Because the surface of the molten tin is dead flat, the glass also becomes flat. The ribbon is then cooled down while still advancing across the molten tin until the surfaces are hard enough for it to be taken out of the bath without the rollers marking the bottom surface; so a ribbon is produced with uniform thickness and bright fire polished surfaces without any need for grinding and polishing.

The most important developments in the process since the 1960s have been in making it continuous, from raw material input to automatic offloading of the finished product already cut to size; and in greatly increasing the loads melted. There have been important extensions to the thickness range and other innovations leading to the production of completely new glass products.

Very few industrial processes of the complexity of float can boast a similar degree of continuity. Its continuity is, in the view of Pilkington and the world's major glassmakers, one of its major advances. Polished plate, itself incorporating considerable steps towards complete continuity, still had an intermittent polishing process and most cutting was manual.

Today's float lines, on the other hand, have the four major stages of melting, forming, cooling and cutting on-line. Achieving complete continuity was, of course, aided by the fact that a continuous finished ribbon was presented to the grinding and polishing (needing no grinding and polishing) was presented by the float bath and this has enabled remarkable developments to be made in cutting and handling technology.

The importance of automating this stage of the process is demonstrated by the fact that half the costs of the finished product to the customer are incurred after the first cut has been made on the continuous ribbon.

Remarkable too, in contrast with St Helens' first float plant, are the differences in scale of today's plants. In 1957 our plant was capable of melting 1,000 tonnes of glass a week (quite enough in view of the fact that it was unsaleable) whereas today's biggest plants can melt over 5,000

tonnes a week as a result of bigger furnaces and bigger float baths.

A result both of the change itself from plate to float and of the greater capacity of today's plants has been considerable increases in productivity with one man able to produce five times as much glass a week as on the plate process.

The increasing price competitiveness of float glass with sheet glass has meant that the industry has been increasingly able to supply float products at the thinner end of the thickness range—previously dominated by sheet. About four years ago Pilkington switched its 4mm flat glass supplies—the type used as window glass in most homes—from sheet to float, thereby providing a better, distortion free product, and one which was easier to cut, without increasing the price.

Increased loads on the float process have also led to the need for higher production, cutting and handling speeds in order to process the greater volumes of glass produced. And as a result of increased speeds too, some rethinking of the technology for controlling glass thickness has been necessary.

A phenomenon of the float process, discovered during the development years, is that of equilibrium thickness; the process in fact wanted to make glass of a particular thickness. It was fortunate that the thickness it "selected" was about 6.5mm as this was the requirement of much of our market at the time.

We had in fact discovered a classic example of a non-spreading system in which equilibrium is established between gravitational and surface tensional forces when the central thickness of a large pool or ribbon of molten glass has reached a definite value.

What this meant practically was, on the one hand, that we were offered the possibility of a forming process in which molten glass could be allowed to spread freely over the surface of the molten metal, the edges of the glass being absolutely free of any shearing forces that could distort the glass; and on the other hand, that our ideas of making the finished glass thicker or thinner simply by rolling a thicker or thinner ribbon of glass on to the bath, were unworkable.

Methods of controlled stretching to make the ribbon thinner and of "building up" the ribbon to make the thicker products were devised. And now these in turn have been modified as speeds have increased.

Commercially, glass from 2.3mm to 25mm thick is now made on the float process. A range of 1.5mm to 50mm is known to be possible and the process has even been used to float a ribbon only 100 microns thick.

The ability to make thin glass—particularly 2.3mm—has been important to the

development of new products, especially for the transport industry. Safety glass has long occupied the minds of makers of windcreens and thin glass technology coupled with advanced toughening technology, has led to production of a new car windscreen which virtually eliminates serious cuts to occupant's face and injures to his head should he strike the windscreen in an accident.

The product, whose first industrial application is in the new 3500, adds the advantages of tough glass to those of a laminated screen, consists of a low-stressed outer glass 2.3 mm for optimum stone resistance, thermally high-stressed inner glass of 1mm for low laceration and a steel inter-layer of polyvinyl butyral.

The fact that the glass is thin means yields and then breaks when the car strikes it and that avoids brain damage. The fact that the inner panel of glass toughened means that it will break into small granules and this greatly reduces the chances of the face being cut.

Conventional laminated windcreens are more rigid and more likely to be damaged. Toughened windcreens using a single panel of toughened glass break into small granules but they may pass straight through on impact.

New glass products have also been developed on-line, by-passing the need for secondary processes. Two products are glass reducing the heat entering a building and, another decorative patterned glass, have been produced by modifying the clear ribbon while it is actually passing on the float bath.

The seed for this novel development was a problem encountered in the years of float when researchers were trying to prevent stannous oxide on the glass surface. The idea was to use the lesson of this problem to draw and to put ions into the glass delivery and at high speed.

The basis of the process is an electrochemical system which drives metal ions into the glass at a controlled depth. Instantly whilst the ribbon is advancing the result is closely-packed and extra fine metal particles about 400 Angstrom in diameter—concentrated immediately below the glass surface where they are impervious to abrasion and clean attack.

Unique features of the float glass process are exploited. First, the glass is horizontal and supported on the electrically conductive medium. So the surfaces of float are finished at high temperature and held at higher temperatures for longer periods than flat glass processes.

Third, the time during which float surfaces are held over a particular temperature range can be controlled. Finally, the hydrogen contained in float bath atmosphere is a suitable agent for converting the ions to metallic state.

This process was first used to produce a bronze solar control glass and there has been a further refinement called pulsed electrofloat, which allows a range of patterns and colours to be inside the glass, leaving the surface of the uneven textures of surface-rolled patterned glasses.

With the growing capability of the process has come a continually expanding list of licensees. Pilkington's policy is not to try to take over the world market for flat glass with its new process, the capital cost would have been prohibitive and massive retooling would have been invited—but rather to build up its established manufacturing facilities such as the United Kingdom, Canada and Australia and offer licenses to other major manufacturers, with the proviso that they should be polished plate glass manufacturers.

Incorporated in the license is an improvement clause which encourages licensees to make further advances in the process and allowing them to supply them free to Pilkington. The first licensees went to Pilkington's United States, in 1962. Today there are 26 licensees in 16 countries with 55 plants in operation and more under construction.

The evidence is that the capability of the float process are far from exhausted and that it will progress to become a universal process for making clear glass.

Sir Alastair is chairman of Pilkington Brothers Limited.

## Potshots at research puddings

by J. C. Polkinghorne

There is great satisfaction in seeing a physical theory neatly fitting the experimental facts. Yet there is an altogether different feeling of excitement when it becomes clear that a set of facts is incapable of explanation by existing theories. One is then on the threshold of new knowledge.

The resulting advance may only be modest. It may be that an over-simplified model of the system considered has to be made more elaborate in order to attain greater realism. Often this involves more labour than inspiration, though on occasions the insight demanded may be very deep indeed.

Just occasionally the challenge presented by the new facts is so profound that a revision of the basic principles themselves is called for. The outstanding examples of this happening this century are the events which lead to the discovery of special relativity and of quantum mechanics. Such dramatic discoveries take place in extreme regimes where matter is examined in conditions as far as possible removed from those in which the established theories have been tested.

Crudely speaking these are the domains of the very large and the very small. Astronomy is concerned with the very large and elementary particle physics with the very small.

The uncertainty principle implies that short distances require high energy, and for that reason the subject is often called by its alternative name of high energy physics. In its earliest days, it relied on

the free supply of energetic particles provided by nature in the cosmic rays which strike the earth. However these are available in an abundance which permits only crude and simple experiments.

The great advances of the past 25 years have resulted from the production of artificially accelerated particles. These come from machines, synchrotrons and linear accelerators, which are gigantic pieces of precision engineering. The quest for shorter distances implies higher energies, which in turn require larger and more expensive machines.

The dimensions of the largest of these are now measured in kilometres. One such, which will share with an American machine the distinction of being the largest in the world, is the super proton synchrotron (SPS) which came into operation at the end of 1976. It is the latest facility to be provided at the European Centre for Nuclear Research (CERN), the international laboratory supported by the countries of western Europe (including the United Kingdom), which for 25 years has played a leading role in the development of high energy physics.

What sort of experiments do the machines make possible? Their general nature can be indicated by a somewhat bizarre conundrum. Suppose one were provided with a Christmas pudding (the particular system under study) and a loaded revolver (the synchrotron or source of high energy particles). The question one has to answer, using the peculiar equipment at one's disposal, is "are there any sixpences inside the pudding?" (Is there structure within the system of a smaller size than the whole system itself?)

The answer to this weird puzzle would require one taking a few pot shots at the pudding (an elementary-particle physicist would say "performing a scattering experiment"). If there are no sixpences inside the bullets will always go straight through, but if there are some they would strike one and be deflected. The more there are the more often this will happen. In an analogous way the high energy physicist attempts, by measuring the degree of deflection in his scattering experiments, to determine the constituents of matter.

Irregular planetary motions to a system of uniform circular motion had been solved by Plato's pupil, Eudoxus, nearly 500 years before Ptolemy, with a system of concentric spheres. Ptolemy's system can be considered as a very much more detailed and sophisticated reworking of Eudoxus's system, using epicycles, eccentrics and equants rather than concentric spheres.

Furthermore, neither the epicycle (which Alfvén mentions) nor the eccentric (which he does not) was original to Ptolemy—they were used by Apollonius and Hipparchus respectively—while the third device introduced by Ptolemy, the equant, was a completely arbitrary way of reducing the observational data to uniform circular motions.

It was this arbitrariness or imperfection, rather than disagreement with observation, that led to the downfall of the Ptolemaic system. It is simply not true that the Ptolemaic system was a "rigid structure incapable of incorporating new discoveries". For observational difficulties could always be patched up by introducing another epicycle or other mathematical device. This however could only increase the arbitrariness of the system and the complexity of the mathematical apparatus, so observational accuracy could be achieved only by sacrificing systematicity and simplicity—precisely what was thought too high to pay.

To call principles like systematicity and simplicity not scientific but mythological or "a priori metaphysics" is to force an unnecessary and damaging stipulative definition on to the historiography of science. This can be shown by the case of Copernicus.

Professor Alfvén writes: "Under the impact of more accurate observations the Ptolemaic system was replaced by the Copernican system." This is false, if by "Copernican system" we understand the system of Copernicus.

First, Copernicus was a theoretician and no observer, and the data he used were no better than Ptolemy's. Second, although of course Copernicus was concerned with observational accuracy, he was even more concerned with what he called "the first principle" as a glance

at the preface to *De Revolutionibus Orbium Coelestium* will show. What Copernicus wanted was agreement with observation but also and above all a simple system which preserved uniform circular motion without resorting to the arbitrary devices that Ptolemy relied on.

A moment's thought will show that Copernicus was quite justified in insisting on these "metaphysical" principles instead of simply going for observational accuracy. For there is no difficulty at all in producing a "system" which is 100 per cent in agreement with the observations you simply list the observational data! But such a system would win no Nobel prizes: it is simply not science. The whole point of scientific research is to produce theories.

Now Professor Alfvén suggests that the theory which resulted from the work of Kepler, Galileo and Newton "was an empirical synthesis, a summary of all astronomical observations ever made". But this cannot possibly be true, for all the astronomical observations ever made had been inaccurate. Newton's theory corrected Kepler's laws, which had made use of Tycho Brahe's observations, and these, though the most accurate there had been, were not accurate enough.

If anything, Newton's theory was a summary of the observations that should have been made, and this is enough to show that the relation between observations and theory is much more complicated than Alfvén allows. It also shows how necessary to theory-building are those principles like systematicity and simplicity, principles without which even the most accurate observations would be scientifically sterile, a fact as well-known to Kepler and Newton as to Copernicus. They had abandoned Copernicus's (and Plato's) uniform circular motion but they had not abandoned the belief in a priori principles in scientific theories.

Another serious inaccuracy in Professor Alfvén's account is his confusion between Aristotelian cosmology and Ptolemaic astronomy. All the astronomical systems from Eudoxus to Ptolemy had been mathematical models introduced "to save the appearances": they were not physical representations of the cosmos. Thus

As a technique such investigations have a long history. It was by just such an approach that Rutherford in 1911 established the existence of the nucleus within the atom, perhaps the most powerful single incentive to the creation of quantum theory. What has happened over the years has been that the probing of matter has been pushed to shorter and shorter distances, revealing successive layers of structure.

One of the most exciting possibilities which could be emerging from the present spate of discoveries in high energy physics is that in an important sense an ultimate level may have been attained.

The contemporary basic ingredients of matter are the celebrated quarks. The indirect evidence for their playing this role is very strong, much of it deriving from experiment, and theoretical analyses in which British physicists have played significant parts, notably the elucidation of resonance structures and the study of certain types of events observed at the CERN Intersecting Storage Rings (ISR). Yet no one has ever found a quark by itself, and not for want of looking either.

This is very puzzling. Returning to the pudding problem, we should occasionally see sixpences by themselves because our bullets would actually knock them out of the pudding. This is what has happened at every other stage of the onion peeling (nucleons knocked out of nuclei, and so on) but apparently not now.

Thus the idea has grown up that maybe the quarks have a new fundamental property. Everything is made up of them but they cannot ever be knocked out singly and seen on their own. In a word, they are confined. If this is so it will have been given to our generation to find a truly fundamental level in the structure of the matter.

Whether this is so, and whether confinement is consistent with, or required by, our present basic physical principles or whether it requires a new fundamental law of physics for its realization, needs further enquiry. Needless to say these questions are being pursued with great vigour in scientifically sophisticated countries the world over.

If the answer proves to be yes it will (fortunately for those endowed with intellectual curiosity) not prove to be the end of all fundamental endeavour on

the frontier of the very small. For, at the same time that these developments are taking place, others are indicating a sequence of discoveries of different types of quarks within matter. The earliest results of the Lind work found in the United States but the recent decision of the German government to build a big electron machine (PEPITA), will, before the end of the decade, put Europe in the forefront of this activity.

High energy physics is intellectually very exciting and never more so than at the present time. It is also very expensive. Our subscription to CERN amounts to more than £18m per annum and several more millions must be spent on preparing experiments in this country in order to extract full value from this. Is it worth it? The question is rather akin to asking if a Rembrandt is worth £1m. In each case one is getting something of high intrinsic worth that represents the culmination of an important aspect of Western culture.

To say that we can no longer afford such activity would be to opt for less than mediocrity and to deny a heritage of extremely successful participation in the endeavour of fundamental physics. It would be to make a decision which ran contrary to that of our European neighbours, the less economically successful such as Italy, no less than prosperous Germany and France.

There are also psychological gains from fundamental science for related disciplines. This is because the different parts of the scientific world interact upon each other more than is commonly recognized.

But are there also gains for the gross national product as well as national pride? I cannot as an elementary particle physicist place my hand on my heart and say I recognize immediate technological consequences flowing from my subject, other than the developments in precision engineering and materials which accelerator construction undoubtedly stimulates.

Yet I am also conscious it is ever thus. Because fundamental science is concerned with extreme regions it always seems remote from the practical world of its time. However, the lessons of history suggest that in the longer run this is not so.

Professor Polkinghorne is in the department of applied mathematics at Cambridge University.

Alfvén's reference to the "Ptolemaic system with the complicated system of crystal spheres" is a serious blunder.

There were no crystal spheres in the Ptolemaic system. The spheres were Aristotle's, but they formed not a complicated but a simple system. Understood realistically, the complicated Ptolemaic system was quite inconsistent with the Aristotelian cosmology. Hence it was not understood realistically, but was seen simply as a convenient mathematical model permitting calculations and predictions. This divorce between astronomy and cosmology was another spur to Copernicus: he insisted that his system was both a mathematical and a physical representation of the cosmos.

Professor Alfvén's version of the history of science is simply a myth, which shows that he is indeed right when he says that scientific progress in recent centuries "does not mean a complete and definite victory of common sense and science over myth". All the facts given here in this article are available to anyone who consults a simple up-to-date history of science. So why has Professor Alfvén failed to notice them? Probably it is because they fit ill with his preconceived notion of science as the march of common sense and empiricism against myth.

This notion is comforting, for at least two reasons. First, it provides a built-in excuse for scientific failure: thus Professor Alfvén suggests that the inability of cosmologists to produce an acceptable theory is the result of their still thinking in a basically mythical way. In fact, though, cosmologists need no excuse: they are faced with an exceedingly difficult task. Secondly, it has a clear ideological value in providing a stick with which to beat those who are sceptical of science: they too are stuck in mythical ways of thought and therefore are irrational. But those who criticize myth in others should beware of the *tu quoque*: when professors of physics write on the development of science, myth rather than history tends to prevail.

The author lectures in the history and philosophy of science at University College, Cardiff.

## Correspondence

### Hannes Alfvén's view—myth or history?

by Andrew Belsey

I was interested to read Hannes Alfvén's article, "Cosmology: Myth or Science?", which appeared in the first issue of *British Association (THEB)*, September 3, 1976.

However, it is puzzling that the 1970 Nobel physics prize winner should appear to be unaware of the very important debates that have transformed the history of science in the past decade or so. Professor Alfvén instead adopts an old-fashioned and discredited positivist historiography, an approach which unfortunately has a tendency to encourage oversimplification, even to the extent of getting the facts wrong.

Professor Alfvén suggests that epicycles were introduced into the Ptolemaic system to get it to agree more closely with observation. But this is nonsense: there was no pre-epicyclic Ptolemaic system. There had of course been other systems of astronomy, and Ptolemy, like the vast majority of great scientists, was building on the work of his predecessors. (There had also been the Aristotelian cosmology, which I shall mention in a moment.)

The basic problem of reducing the



BRITISH ASSOCIATION



Annual meeting

The annual meeting of the British Association for the Advancement of Science has been held since the creation of the association in 1831. The 139th meeting will take place at the University of Aston in Birmingham from August 31 to September 6, 1977, under the presidency of Sir Andrew Huxley, FRS.

This of itself must be a notable event, not simply because Sir Andrew is a Nobel prizewinner, having been awarded this distinction for his remarkable researches into the mechanism of nerve impulses, but because he will be the second member of his family to impress his influence on a BA annual meeting.

In 1860, his grandfather, in expounding the evidence upon which Darwin had based his hypothesis of evolution and the origin of species and overturning Bishop Wilberforce, changed the current of thinking, not only in Great Britain, but throughout the educated world. It would be a bold man who would assert that today there are no longer deeply held beliefs which are embraced rather because we wish they were true than because there is convincing evidence that this is so.

At the meeting in Birmingham next September, a city last visited by the association in 1950, more than 300 papers on diverse aspects of science as well as on engineering, agriculture, education, sociology, geography and much else will be presented besides the presidential address.

These are all designed to take a reflective view of the state of British science and the way it relates to our society. Each lecture and debate is aimed at the layman—or at a scientist specializing in a different field—whether he has a specific need for scientific or technological information in his work, whether he is interested in the unfolding of scientific knowledge or whether he (or, of course, she) is concerned with the application of science and technology to the economic prosperity and well-being of the nation.

For those who can spare the time, the ideal arrangement is to attend the whole week of the meeting and thus savour the full sweep of events and enjoy the delights of rubbing shoulders with a diversity of scientists in full cry. Because this is not always possible, the programme has been organized so that visitors can come for part of the week or over the weekend and select which of the lectures and other events he or she wishes to attend.

This provides the opportunity to choose a highly individual programme. For example, managers in industry (and Birmingham claims to be the industrial heartland of the kingdom) can select lectures on engineering, or chemistry, or economics which will be of practical value to them. Such useful parts of the meeting may be scattered throughout the week. Indeed, those who have planned the meeting have gone further still.

At the Aston meeting, specific sections believed to be of particular interest to people commonly described as "middle management" have been gathered together within the week's programme into "packages", extending over only one or two days.

The papers falling within these "packages" will be published in advance. They will cover such topics as: For example, "Coping with complexity". Attendance at such a two-day symposium will involve

BA Annual Meeting, August 31-September 6, 1977. Please send me further information about the Annual Meeting at Aston as soon as it becomes available.

- I am particularly interested in:
- [ ] Attending the whole meeting
- [ ] Group visits
- [ ] Scientific lectures
- [ ] Management programme
- [ ] Scientific and industrial visits
- [ ] Careers events
- [ ] Young people's events

BA ANNUAL MEETING 1977, University of Aston, Freeport, Birmingham B4. \*No stamp required.

NAME ADDRESS

an expenditure of less than £30 including the cost of publications and accommodation on the campus.

The planning of the meeting in this way is designed to encourage more people in industry who are involved in the day-to-day use of science and the technologies derived from it to benefit from a unique opportunity to broaden their knowledge and understanding.

The plan to merge the exposition of new discoveries in science with the practical applications of science has been extended so that much of the programme will be of particular interest to young people. As a result of generous support from the Foyie Trust, a number of young people will have their attendance financially sponsored. Furthermore, in addition to the lectures and scientific visits which constitute the core of the meeting, there will be a series of events designed to illustrate the way in which science is involved in a worthwhile career. The ideas so far discussed include the design and operation of an oil rig, a pacemaker, and the manufacture of man-made food.

There is good reason for the British Association to claim that its annual meeting remains today, what it has always been, the parliament of science.

Report to the nation

It is likely that at the Aston meeting there will be a major public announcement of the results of an intensive research project initiated by the British Association and jointly sponsored by the government and industry on the topic: "What steps are desirable with respect to the education (including career advice), recruitment and deployment of professional level engineers, to improve the performance of British manufacturing industry and in particular the effectiveness of production management."

The report will be the subject for the first time of public debate to which all sections of the community and government will contribute. The most senior managers of industry in Britain will be invited to participate in both the reporting and discussion sessions on the report now being planned to take place on the evenings of Thursday and Friday, September 1 and 2, 1977.

The project, aimed at assisting Britain's industrial performance by investigating the contribution made by professional level engineers to manufacturing industry, is to be undertaken under the auspices of the British Association with full backing from the government, industry and the scientific world.

The objective of the project is to recommend action to be taken in the education, recruitment and deployment of engineers to improve the performance of the British manufacturing industry, and, in particular, the effectiveness of production management.

The inquiry will be conducted by a specially recruited, full-time team based at the University of Aston in Birmingham. The theme has arisen out of discussions between the British Association, the Royal Society and the National Economic Development Office during which it was emphasized that the engineer plays a leading part in determining the technical competitiveness of manufacturing industry.

It was also stressed that the British Association has always been particularly concerned that the application of science and technology should be as efficient as possible so that they can make their fullest contribution to the economic performance of a modern technological society and the revitalization of the nation's economy.

Consultations with senior officials in government departments, including the Central Policy Review Staff, as well as industry, the Council of Engineering Institutions and other interested parties, have ensured the widest possible backing from all quarters.

Extensive information relevant to the project is already held by government departments, industry, the CBI, Joint Bodies such as the Engineering Industry Training Board, and the engineering profession itself. This knowledge will be made available to the project team, together with informed comment and suggestions for action.

Cooperation has already been confirmed from the Departments of Industry, Education and Science as well as the Manpower Services Commission, the National Economic Development Office, the Council of Engineering Institutions,

the Schools Council, the TUC, the CBI and a number of individual companies.

A British Association coordinating group has been formed to launch and monitor the project; it consists of representatives of all the above bodies and substantial representation of the major British companies and nationalized industry.

The project team itself will operate under the direction of the vice-chancellor of Aston University, Dr J. A. Pope, who, as well as having interest in industry, is also the general treasurer of the British Association. The resulting report will be published in July 1977 so that public discussion of the findings can culminate in an informed debate at the annual meeting.

The membership of the coordinating group is made up of Lord Baker, Dr T. Gammerson, Sir Andrew Huxley, Dr J. A. Pope, Dr Magnus Pyke and Sir Lincoln Ralphs, representing the BA; Sir Alan Cottrell, Professor D. W. Holder and Sir James Menter representing the Royal Society; Sir Ronald McIntosh and Mr B. Asher of the National Economic Development Office; Mr G. A. Dummett and Mr M. W. Leonard of the Council of Engineering Institutions; Sir Kenneth Berrill of the Cabinet Office; Sir Alex Smith of the Schools Council; Mr James Hamilton of the Department of Education and Science; Sir Peter Carey of the Department of Industry, and Mr Richard O'Brien, chairman of the Manpower Services Commission.

Other members of the group are Sir Alec Cairncross, Lord Nelson, Lord Hinton, Mr H. H. Tomlinson, Sir Frederick Dainton, Professor J. H. Horlock and Mr John Methven. In addition representatives of schools, the research councils and industry have agreed to serve.

The coordinating committee is supported by a BA management committee with Sir Ieuan Maddock as chairman together with Dr J. A. Pope, Mr F. McCallie, Mr W. A. Mallinson, Mr J. A. Jenkins, Mr M. Best, Sir Alan Cottrell, Major General Sir Leonard Atkinson, Professor Sir Sam Edwards, Mr R. G. Fisher, Mr P. Chappell, Mr P. A. Baker, Mr A. Thompson, Miss A. E. Mueller, Mr H. R. Windle, Mr V. Edkins and Dr John Rae. Mr D. Dibsall of the Department of Industry acts as secretary.

Finally, there is the project team itself. This is made up of Dr J. A. Pope as the general director together with Mr Vincent Edkins, sometime managing director of Guest Keen Williams Ltd., as senior project officer; Dr Stuart Macdonald of the Technology Policy Unit at Aston, Mr James Walter, a graduate student of industrial administration, and Mr Richard Swaine, who has been seconded to the project by IBM.

Branches and BAYS

Not everyone realizes how much the British Association does to show young people what science is and explain to them the way in which it colours our influences, the kind of life we live today, the interests of their pupils in science but inevitably the fact that scientific subjects are part of the school syllabus has a tendency to deaden the interest of some of less imaginative boys and girls.

Also there is a good chance that scientists who are themselves engaged in research and are thus involved in the actual process of unravelling new knowledge; must possess a certain legitimate glamour in the eyes of young people. It is on this premise that devoted men and women, members of the BA living and working in various parts of the United Kingdom, have formed themselves into the 17 territorial branches of the BA.

These branches organize meetings of various sorts at which specialists in the and different sciences as well as engineers and technologists speak to young audiences. These meetings are often arranged in collaboration with local education authorities. They are sometimes held on university premises. When they are concerned with applied science they may be supported by the Department of Industry.

A further series of events which have proved to be of equal interest and excitement both to those who come to speak and those who come to listen is the scheme supported by the Royal Society. This is the British Association of Young Scientists (BAYS). Royal Society Lectures

Distinguished fellows, whose names are household words in the world of scientific

research, talk to the young people about their work. Who can tell us sparks are kindled among the members, their audiences seeing and hearing the actual people who make the discoveries are like? And this brings us to a description of BAYS.

BAYS comprises young BA members usually belonging to a group of schools in a locality. Each one is interested in science. They pay their subscriptions: 30p and, with some help from the headquarters, band together to form a branch with their own president, secretary and treasurer.

There are now more than 70 branches with a total membership exceeding 1000. Science fairs have over the years proved to be a popular means for engaging young people in active participation in science. They are not a direct part of the programme of BAYS nor do they necessarily originate from a branch of BA itself. At the same time, BA branch members and members of BAYS branches may be involved in them.

A science fair is organized by its or local committee in which a variety of people may be involved. Some may come from local industry, others from school and local education authorities. Universities, polytechnics and technical colleges in a vicinity may also take part and financial support come from diverse sources some official, some voluntary.

For several years generous provision has been made by The Sunday Times. The result is a cooperative effort involving young people and their schools demonstrate in simple terms by & younger pupils and in surprisingly complicated and sophisticated ways by the more senior what they are doing in science.

An added attraction for the participants is to be simplified out by the BBC take part in the television programme "Young Scientist of the Year".

To join the BA and take part in branch activities readers should send a cheque for £3 to the membership secretary, 11 Fortress House, 23 Savile Row, London W1A 1AB. To find out about the programme in their own areas they can write to:

Edinburgh: Dr G. H. W. Milburn, Napier College of Science and Technology, Colinton Road, Edinburgh EH10 5DT, Glasgow and West of Scotland: Dr J. G. Macdonald, Department of Extramural Education, The University, 57/59 Colfield Avenue, Glasgow G12 8LW, Tayside and Fife: Mr A. G. Robinson, Director of Extramural Education, The University, Dundee DD1 4HN.

Cleveland: Mr C. J. Bullock, 7 Darlington Road, Hartburn, Stockton, East Midlands: Mr J. K. Tollyfield, The Polytechnic, Clifton, Nottingham NG1 8NS, Merseyside: Mr S. D. Horne, Merseyside County Museums, William Brown Street, Liverpool L3 8EN, Northern Regional Council: Mr N. Duffson, 4 Phillips Avenue, Middlesbrough Cleveland TS5 5PP, North of England: Mrs M. D. Morrison, Department of Adult Education, The University, Newcastle upon Tyne NE1 7RU, North Western: Dr M. Spencer, Department of Chemistry, University of Salford, Salford M5 4WT, Norwich and Norfolk: Mr R. R. J. Science Department, City College, Ipswich Road, Norwich NR2 2LP, Oxford: Mr W. J. Jackson, The Lat Spencer Churchill College of Education, Wheatley, Oxford OX9 1HX, Sheffield: Dr J. M. West, Department of Metallurgy, The University, Sheffield, Southern: Mr R. H. Gammon, Southern Science and Technology Forum, The University, Southampton SO9 5NH, Sussex: Mr H. S. Llewellyn, Brighton Polytechnic, Moulsecoomb, Brighton BN1 4GJ, West Midlands: Mrs I. Mills, Birmingham and Midland Institute, Margaret Street, Birmingham B3 3BS, West Yorkshire: Dr R. P. Sheldon, The University, Bradford 7, South East Wales: Mr D. E. Morgan, Waun Wen, Maendy, Cowbridge, Glamorgan CF7 7TC, South West Wales: Mr T. R. O'Connell, Department of Geology, University College of Swansea, Glamorgan, Northern Ireland: Dr F. C. McLaughlin, Department of Electrical Engineering, Queen's University, Belfast BT7 1NN.

Magnus Pyke

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Innenpolitik

Imperial Germany edited by James H. Sheehan New Viewpoints, £7.50 ISBN 0 531 05374 1

The new school of German history is much concerned with continuity and discontinuity. They re-interpret German history from the foundation of the Empire in the end of the Third Reich as a continuous historical development in a multi-faceted direction and imply that this continuity was their lodestone. Imperial Germany enables the reader with no German to acquaint himself with their ideas.

Their central doctrine is explained most clearly in an important essay by Wolfgang Mommsen which comes chronologically at the end of the book. This doctrine is the primacy of domestic policy: das Primat der Innenpolitik. Professor Mommsen himself contests the validity of the doctrine and Otto Hülse in a series of clear and cogent pieces of writing is content to explain Bismarck's foreign policy within the logic of foreign policy. But otherwise the belief that foreign policy was determined by economic, social and ideological causes colours the whole book.

Karl Erich Born in the first chapter draws its base line when he writes: "Germany changed between 1870 and 1918 from an agrarian to a highly industrialized country." He then calls attention to the broad effects upon the structure of society of the disappearance of the old *Bürgertum* and the appearance of the new proletariat. Hans Rosenbergh then deals with this downward surge of the wave of economic expansion which began to go upward in 1849 and turned downwards in 1873.

Furnished with this economic material the reader comes next to James J. Sheehan's thesis that the criteria of wealth, status and power by each working so as to place differing people in the top and middle classes created those social disaffection which made it necessary to use foreign expansion as a safety valve for domestic political purposes.

In the short compass of the next essay there is something of much more than particular significance. Duo importance is given to the government of imperial Germany by civil servants making their living out of their profession rather than by parliamentarians and politicians.

John Röhl can show how politics turned out by one poor, came in by another. Increasingly during the last decades of the Empire those at the top of their profession who might expect appointment in favour of less well qualified men, the aristocratic heads of the provincial administration who knew more about power and its exercise. Government at the highest level demanded political skills whatever the Bismarckian constitution might have arranged.

Hans-Ulrich Wehler's essay on Bismarck's imperialism, 1862-1890, is the perfect application of the doctrine of the primacy of domestic policy. It is the extent by which the views of the school must be judged. Imperial expansion, informal or formal, Professor Wehler argues, was caused by a social system under pressure striving to retain its validity. Bismarck's aim was social stability in a situation where uneven economic development, resulting from rapid industrialization, was causing social stress. His social policy was the internal aspect of a stabilizing policy of which the external aspect was imperialism. Imperialism was thus an integrating factor which found anglophobia and anti-semitism useful instruments. The question is not which explanation, that of Professor Wehler or that of other scholars, he has pointed to the primacy of domestic concerns in Austria's relations with Germany. He has used a wealth of secondary material and many unpublished Austrian and American doctoral theses. For this we must be grateful.

One cannot, however, fail to express a number of serious reservations. The author's basic aim is to show the Austro-German example to equally similar states can exist side by side, and yet not unite. He freely admits that the original inspiration for the study came from his ponderings about the future of Germany. The distinguished partner

Agatha Ramm

BOOKS

Women's place

The Feminist Movement in Germany 1894-1933 by Richard J. Evans Sage Publications, £7.00 and £3.50 ISBN 0 8039 9931 8 and 9996 8

Richard Evans's book on the feminist movement in Germany is not only a contribution to a previously neglected area of study but also a further aid to our understanding of the nature and failure of German liberalism in the advent of the Third Reich. For, as he points out, the feminist movement derived its major inspiration from the values of liberal individualism.

The basis of the book is a well researched chronological narrative of the development of feminism in Germany. It began in the 1860s as a relatively conservative movement which concentrated almost exclusively on the issues of expanding educational opportunity for women and opening up recruitment to the medical profession. At this time the radical goals of the 1848 revolution had been abandoned as much liberalism as they had by German educational reformers. There was no attempt to claim equality of status with men but a desire to show that within the accepted social framework women did serve the community in their own particular way.

It was in the 1890s and especially between 1894 and 1908 that a marked radicalisation of the feminist movement took place; and according to Evans this correlated with a general move to the left on the part of German liberalism and to a greater sympathy on the part of individual male liberal politicians for at least some of the aims of feminism. In this period the movement not only grew in number but began to demand female suffrage and on occasion a new morality, involving sex education for children, the recognition of marriage as free and equal contract, easier divorce, wider use of contraceptive measures and on occasion the right to abort. This last demand, however, was still rejected at the most radical conference ever held by the major feminist

ship of Austria and Germany is used as a "case study" to point to a possible pattern of relations between the Federal Republic of Germany and the German Democratic Republic. Perhaps contrary to his intentions, Dr Katzenstein has shown us how unlike the Austro-German case it is, therefore, doubtful whether any universally applicable conclusions can be drawn.

Some questions must be raised about his method as well. The author has attempted to trace the evaluation of Germany in Austria by analysing the Crown speeches of the Emperor and the inaugural speeches of his prime ministers as well as the New Year's Eve editorials of the leading Viennese dailies. He noted the presence or absence of Austrian and German symbols in such speeches and editorial, and then correlated the results statistically. The result, we are told, is a conspicuous assessment of attitudes towards Germany among Austria's governmental and non-governmental elites. It might have been more worthwhile to have paid some attention to the papers of the Austrian Foreign Ministry and individual Austrian politicians and public figures, many of which have already been published or are available in Vienna archives. Again it might have been better to have analysed some obviously significant editorials and speeches in depth rather than to have processed such a large number statistically.

On the other hand, it must be admitted that in other instances Katzenstein has used statistical material to benefit. His analysis of foreign news coverage in two of the major Viennese dailies shows quite effectively how Austria perceived of its role vis-à-vis Germany over the years. The figures presented relating to the flow of mail, telegrams and telephone messages have also enhanced his argument.

Michael Riff

Separate development

Disjoined Partners: Austria and Germany since 1915 by P. J. Katzenstein University of California Press, £9.45 ISBN 0 520 02945 3

"Two states, one nation": this is the formula currently used to express the status quo in Europe with respect to the many thornier states of political union. It is the prospect of an eventual solution to the problem of German reunification, never is even the slightest mention made of Austria. However drastically, the Second World War has relegated the word *Austrius* to the scrapheap of history.

Dr Katzenstein takes us up to this juncture, and beyond. We are given insight into why Austria and Germany, although sharing the same language and culture, only formed a single, united state once—under Nazi rule (1938-45). He shows us, that, in a sense, the *Austrius* was a deviation from the pattern. For the rest of the period in question the balance of co-pressures and "counter-pressures" was such that unification did not occur. When it did happen, moreover, Hitler and his supporters were more than his helpmates.

In broad terms Katzenstein has presented us with an entirely plausible and well constructed argument. Like other scholars, he has pointed to the primacy of domestic concerns in Austria's relations with Germany. He has used a wealth of secondary material and many unpublished Austrian and American doctoral theses. For this we must be grateful.

One cannot, however, fail to express a number of serious reservations. The author's basic aim is to show the Austro-German example to equally similar states can exist side by side, and yet not unite. He freely admits that the original inspiration for the study came from his ponderings about the future of Germany. The distinguished partner

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# BOOKS

## Party times

The Growth of Parliamentary Parties 1689-1742  
by B. W. Hill  
Allen & Unwin, £7.95  
ISBN 0 04 942149 2

It is often forgotten that Sir Lewis Namier's seminal study of eighteenth-century politics and patronage was intended as a picture of political structure at the accession of George III. Dr Hill argues against the extension of Namier's period to the period before the death of Walpole. He shows that after 1689 regular parliaments and a free press provided the conditions and stimulus for the development of party. The issues which brought about the Revolution and other issues which it aroused (issues concerning the church, the succession, finance and foreign affairs) remained essentially matters which divided parties.

After 1689, the Whigs were in power and the Tories in opposition, and this necessitated some (often uncomfortable) adjustments of principle. But the failure of William III and Anne to create an independent court party is evidence of the strength of party feeling. Under Anne, the imminent succession question and the High Church challenge posed by Sacheverell intensified and clarified the still fundamental rift. Though both parties sought office, it was not office at any price. Harley failed in his attempt to overcome party differences.

Tracing the story of parties to the death of Queen Anne, Hill provides the first full narrative which incorporates recent research into divisions and political movements. Together with his own exhaustive study of pamphlet literature and political correspondence, he has sketched for the first time a complete picture of the place of party in politics during both reigns. But Hill is not simply arguing for the survival of party, and of the issues which fostered party, beyond the death of Queen Anne and through the years of Walpole's supremacy. After 1715 the Whigs were indeed divided among themselves in personal quarrels and by divergent attitudes to the Church, the powers of the crown and the conduct of foreign affairs. The Tories, too, split from their Jacobite wing and sought, in the face of a political wilderness, to pursue their office as Whigs. But for the most part, the two parties survived intact. The Tories in particular showed great consistency in divisions from 1715 to 1754. Though they were in opposition, there was always a sense that they were the Tories might be approached to form an alternative government. We should not be blinded by hindsight from seeing this possibility, especially when both Georges dangled it, as threatening axes, before the Whigs.

Divisions between parties were still an important feature of Walpole's political world. His own long tenure of office owed much to the reluctance of most Tories and Whigs to join in opposition to the ministry. Those like Bolingbroke and Castlereagh who tried to use parties for their designs, rather than follow any party programme, were the failures of early eighteenth-century politics. Walpole was so splendidly successful because he completed the transformation of the Whigs into a party of government.

Hill presents his argument with care, detail and scholarship. It is none the less convincing because he is always ready to note the exception or to make a qualification. His style is not easy to read and few concessions are made to the reader. Since the shifts and turns of diplomacy and conflict in Europe played so much part in political alignments in England, a clearer picture of the European situation was needed as a backcloth to the stage of domestic politics. Hill's argument will not be fully appreciated by the student who has not already read much about the period. But if his is a book which returns a high dividend, it is a study which makes a permanent contribution to our understanding of the political world after 1689.

## Keeping shop

The Inland Trade: Studies in English Internal Trade in the Sixteenth and Seventeenth Centuries  
by T. S. Willan  
Manchester University Press, £5.95  
ISBN 0 874718 538

Professor Willan's new book is, as its sub-title suggests, necessarily something of a miscellany. In many ways his studies of Elizabethan and Stuart retailing form the most interesting part. Though a contemporary lawyer saw retailers as "not worthy the name of merchants, but of hucksters... who, retailing small wares are not able to better their own estate but with falsehood, lying and perjury", the author has not underestimated their importance. He shows too that retailers and wholesalers in fact merged imperceptibly at the margins.

Although he deals with fairs and markets, Professor Willan is interested in the smaller men. He finds pedlars less important than some previous writers and the provincial shopkeepers more significant. Bigger towns boasted a large number of shops—Norwich had 150 grocers alone in 1563 (perhaps not all retailers)—but who would have suspected that a Shrewsbury bookseller possessed 2,500 volumes in 1585 or that a shopkeeper of diminutive Kirkby Lonsdale had a bewilderingly varied stock, ranging from both patience and judicious scholarship. It is a matter for gratitude that Professor Willan provides such exemplary guidance, enlivened by his usual dry humour. This collection of fascinating studies remains as how much remains to be done in the interdependence of Church and State; and there is a particularly good chapter on Church-State relations between 1828 and 1846. Another theme is that the Church's leaders derive their social view from their peers among the intelligentsia and not from theology; hence their conflicting opinions and the fact that they invariably mirror the common assumptions of the day. This leads to a refreshing assessment of the Church's (as opposed to the Evangelical) rôle in the half century before 1830 and to an analysis of how influential Churchmen have consistently related social teaching and vital religion. There is nothing new about such concerns, although each generation has had to rediscover the relationship for itself. Norman is reader to doubt the efficacy of the "Christian Sociology" of the 1930s, than of the practical Christians of a century before.

Then there is the Church's avoidance of party politics. To all Dissenters, the Church was the Tory Party at prayer (who coined that phrase?), even though most Liberal voters, like most Liberal MPs, must demonstrably have been loyal Churchmen. As Norman expresses it, Church leaders were not political as they just belonged to the political classes. He never quite explains why clergymen appeared more class bound than mere politicians.

Yet the suspicion remains that this excellent book is only a tract; indeed the nature of its argument is such that it cannot be other than the product of some intellectual fad of its day—in this instance an apparent anti-intellectualism, appropriate for examining the Anglican mind, possible only for one with inside knowledge. A *transitus des ceteris* indeed.

For clear common sense slides as readily as radical obfuscation into bias. Thus, in the clerical stoat, there is Norman's twentieth century, the only survivors are the Christian realists of the 1940s and 1950s: but his own fortunate years? We are often told, too, what "most" people thought, without quantitative evidence, and without it always be-

complaints of urban retailers indicate an increasing concentration on village shops.

Both the sections on these party traders and those on Elizabethan carriage underline the impression of a society whose web of commerce and communications was at once more intricate and more flexible than that pictured by (for example) certain transport historians' "wild" and "compulsively readable." It begins as a perceptive reappraisal of the Church of England's mind about society from the late eighteenth century onwards. It ends as a "Jennifer's Diary" of the Anglican intelligentsia from which no radical survives unscathed. Coleridge is shot down by the coining of that phrase?), even though most Liberal voters, like most Liberal MPs, must demonstrably have been loyal Churchmen. As Norman expresses it, Church leaders were not political as they just belonged to the political classes. He never quite explains why clergymen appeared more class bound than mere politicians.

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Such research clearly renders both patient and judicious scholarship. It is a matter for gratitude that Professor Willan provides such exemplary guidance, enlivened by his usual dry humour. This collection of fascinating studies remains as how much remains to be done in the interdependence of Church and State; and there is a particularly good chapter on Church-State relations between 1828 and 1846. Another theme is that the Church's leaders derive their social view from their peers among the intelligentsia and not from theology; hence their conflicting opinions and the fact that they invariably mirror the common assumptions of the day. This leads to a refreshing assessment of the Church's (as opposed to the Evangelical) rôle in the half century before 1830 and to an analysis of how influential Churchmen have consistently related social teaching and vital religion. There is nothing new about such concerns, although each generation has had to rediscover the relationship for itself. Norman is reader to doubt the efficacy of the "Christian Sociology" of the 1930s, than of the practical Christians of a century before.

Then there is the Church's avoidance of party politics. To all Dissenters, the Church was the Tory Party at prayer (who coined that phrase?), even though most Liberal voters, like most Liberal MPs, must demonstrably have been loyal Churchmen. As Norman expresses it, Church leaders were not political as they just belonged to the political classes. He never quite explains why clergymen appeared more class bound than mere politicians.

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B. F. Duckham

# BOOKS

## Inside the Anglican mind

Church and Society in England 1770-1970: A Historical Study  
by E. R. Norman  
Clarendon Press: Oxford University Press, £15.00  
ISBN 0 19 826435 6

Church and Society is Edward Norman's most important book: it will make him few friends. It is substantial, infuriating, often horribly funny and compulsively readable. It begins as a perceptive reappraisal of the Church of England's mind about society from the late eighteenth century onwards. It ends as a "Jennifer's Diary" of the Anglican intelligentsia from which no radical survives unscathed. Coleridge is shot down by the coining of that phrase?), even though most Liberal voters, like most Liberal MPs, must demonstrably have been loyal Churchmen. As Norman expresses it, Church leaders were not political as they just belonged to the political classes. He never quite explains why clergymen appeared more class bound than mere politicians.

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Kevin Sharpe

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## Epidemic

Cholera 1832  
by R. J. Morris  
Croom Helm, £7.50  
ISBN 0 85664 377 7

This study of the morbid pathology of British society in 1832, a fascinating example of complacency undermined by terror. The ravages of the first cholera epidemic in England—here graphically described from medical and literary sources—threatened social stability, and the equilibrium of classes although its demographic impact was smaller than that of earlier plagues. The unpredictable course of the disease and its fearful symptoms strained relations between rich and poor, exposed the low standards of sanitation and public health and provoked considerable debate among doctors and theologians.

The crisis created by the epidemic revealed certain weaknesses in contemporary society. At one extreme it confirmed prophecies of the second coming, at the other it caused worry about the burden on the rates. Medical resources were shown to be inadequate and the doctors, obsessed with internal professional conflicts, failed to understand the disease. The branches of medicine which enjoyed greatest prestige were not those which could carry out the research needed to control cholera. The clergy emphasized the value of prayer, associated cholera with drink and advised moral strength to overcome ignorance and insecurity.

Disputes between the medical men and the administrators, local independence of central control, indecision and a general failure of authority made even the distribution of supplies and preventative measures ineffective. Both external and internal quarantine arrangements failed and the disease spread from Sunderland because those in charge surrendered to pressure from vested interests. There was a reluctance to see, can business to stop trade, abetted by medical confusion.

Although the social analysis is sometimes convoluted and repetitively overstated, the general thrust of the argument is forceful and convincing. This is a stimulating and successful attempt to examine the structure of a society under stress.

Richard Grassby



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# BOOKS

## Fall of the Anglo-Irish

The Anglo-Irish Tradition  
by J. C. Beckett  
Faber & Faber, £5.50  
ISBN 0 571 10988 X

In a typically modest preface, Professor J. C. Beckett describes his book as "a work of reflection, rather than of research"; but a book by Ireland's most distinguished historian, based upon a lifetime's reading and thinking about his country's past, is an event of major scholarly importance. Beckett's unique contribution to Irish historical scholarship lies not only in his cool, balanced treatment of his subject, but also in his ability to deduce from the evidence coherent patterns of development in Ireland's confused and troubled history.

It is just such a pattern that Beckett discerns in his study of the Anglo-Irish tradition. There might seem to be little connexion between the motley handful of Anglo-Norman, Welsh and Flemish soldiers who landed at Baginbun Head in 1169 at the invitation of the king of Leinster, and such great names as W. B. Yeats, Henry Grattan, or Sir Edward Carson. Beckett points out that they were the true formers of the Anglo-Irish in a political sense, in that they laid the foundations of English power in Ireland. Later generations of British settlers inherited many of their ideas and assumptions about Ireland and about their place in Irish political and social life. And although the Anglo-Irish differed from the majority of the population in religion, although they were members of the established church, they came to think of themselves as the "Irish nation". They built an ascendancy that flourished in the eighteenth century, and was undermined, and finally extinguished, in the nineteenth and

twentieth centuries. It is the contribution made by the Anglo-Irish to the development of modern Ireland that Beckett describes and explains in his book.

The word "contribution" might seem to many an inappropriate one; an Irish nationalist might quibble, perhaps asking whether one can talk about the "contribution" of the Huns to fifth-century Europe. Beckett argues convincingly, and with characteristic eloquence, that there is no reason for the historian (as distinct from the political propagandist) to regard the Anglo-Irish as anything less than Irish through and through. Although their concern for Ireland was, naturally enough, mixed with a healthy concern for their own interests, this did not prevent them from making a valuable and lasting contribution to their country. In politics, economics and the arts, their arrogance and self-confidence, their sheer ability, and talent, enabled them to found Ireland's parliamentary tradition, to develop her economy, to grace her countryside with pleasing architecture, to enrich her literature, and, indeed, English literature, with fine novels, poetry and drama.

And yet, despite their achievements, the Anglo-Irish suffered from a dangerous flaw in their character: their ambivalence, their ambiguity of outlook, arising from their need to be at once Irish and English. They could, for example, write about the Catholic peasantry, as did Synge; but they could not see that the outside, since they could not share that peasantry's experience. For the Anglo-Irish that ambivalence became acute when in the late nineteenth century they were confronted with a Catholic Irish nationalism which stressed not only their identity with, nor success-fully resist.

A. i.e., like Thomas Davis, tried

to shape Catholic nationalism into a non-sectarian mould, but they only scratched the surface, and helped call into existence a nationalism which drove them from public life. It would have been interesting if Beckett had considered more fully the Anglo-Irish nationalism, which included Constance Gore-Booth (Countess Markievicz) and other figures like Robert Barton, one of the Sinn Féin signatories of the 1921 treaty. Why did they commit themselves to a Gaelic Ireland? What attraction did it hold for them?

It might seem, therefore, that Beckett is after all the author of a work of historical pathology. Of course, all history is in some pathology; but the Anglo-Irish as a particularly dead duck. Beckett will not allow that their tradition survives in the north-east part of Ireland, which he regards as embodying a different, more self-regarding, Irish tradition; and in the south and west of Ireland their numbers have dwindled rapidly since the Irish Free State was created in 1922. Beckett argues that their fate is of concern to the country's future as well as its past. Their experience of power and the loss of power; their resultant wisdom and breadth of outlook; their frank recognition of the necessarily close relationship between Britain and Ireland; these are qualities that modern Ireland needs, and cannot find. Beckett does not imply that such a comprehensive legacy is likely to be valued in the polarized Ireland of today. But it takes a brave historian to say that it should. In this, as in all his work, Beckett reveals his breadth of learning and also his sympathetic, yet sternly realistic, view of his fellow countrymen.

From there we proceed to two essays dealing with crises in the medieval economy of the importance of which has been inadequately appreciated in the past. P. D. A. Harvey pulls together the evidence which shows that the years 1180-1220 were a time of inflation so violent that they take their place with the sixteenth and twentieth centuries. The causes to which he attributes the inflation are debatable, but it was predictable that from it came an endeavour to keep their incomes abreast of a soaring cost of living, it spurred landlords to make the most of their land and to press to their rights over the dependent peasantry. I. Kershaw's essay on the crisis

D. G. Boyte

## Primary sources on slavery

Slavery, Abolition and Emancipation: Black Slaves and the British Empire  
by Michael Craton, James Walvin and David Wright  
Longman, £4.50  
ISBN 0 582 48993 0

In recent years the scope of slavery studies has been steadily enlarged, reflecting scholarly uneasiness about neglect of the early phases of slavery and the slave trade, about the habit of examining the experiences of different peoples with these institutions in isolation and about relying on literary evidence and ignoring the position of free people of colour in slave societies. Interest in slavery has also grown among students for it is a subject which lends itself well to the fashionable thematic, interdisciplinary and comparative approaches to history. Moreover, while many students are motivated by simple indignation at the explicit exploitation and white racism, their attention is

kept by the complexity of slave systems, slave behaviour, African attitudes to the slave trade and abolitionist activities.

The thoroughly up-to-date documentary on slavery in the British Empire by Craton, Walvin and Wright will meet the demand among contemporary history students, from school age onwards, to use primary materials. There are sections containing annotated extracts on the African trade, plantation slavery, slavery and the law, the intellectual origins of anti-slavery, on abolition, emancipation and apprenticeship. These are prefaced by the findings of modern scholarship and conclude with useful suggestions for further reading, both at the documentary and secondary level.

The authors aim to present their topic "objectively and whole". Thus though they emphasize the "ubiquitous role of economics" in their treatment of the philanthropists, they give due weight to humanitarianism. Partly because of source difficulties, however, not all

the themes embraced lend themselves to effective illustration, especially in brief.

The changes in plantation slavery over time and from place to place, and the process of slave acculturation will be difficult for the novice to appreciate from what is shown here, and there is a heavy reliance on this context on the example of Jamaica. The debate about the profitability of the slave trade is not adequately conveyed, any more that are the problems of quantitative studies. It is far easier to represent the anti-slavery argument through the writings of leading exponents than to show the popular response to it, or to demonstrate their relation to the lengthy, political manoeuvres involved in abolition. The importance of which the authors acknowledge. Finally, source bias is explained in the same direction, and the author's argument is described, their individual influence or claims to be representative are not always assessed.

Christine Bolt

# BOOKS

## Fruitful debates

Peasants, Knights and Heretics  
edited by R. H. Hilton  
Cambridge University Press, £5.00  
ISBN 0 521 21276 6

From time to time *Past and Present* has arranged for the publication of essays on a common theme or period which first appeared in its pages. These collections have demonstrated why, over the past few decades, *Past and Present* has so rapidly established its high reputation among historical journals. This collection, in quality those that have preceded it and is probably the best introduction available to many of the debates in progress among students of medieval social history and to some of the basic re-interpretations of medieval society that are being worked out.

The book begins overtly with a debate: that between Joan Thirk and J. Z. Titov on the origins of the medieval common fields and the chronology of their development. In fact, with hindsight, one wonders whether their views were not more compatible than they appeared to be at the time; but at least this begins at the beginning, the land from which medieval men produced their daily bread.

From there we proceed to two essays dealing with crises in the medieval economy of the importance of which has been inadequately appreciated in the past. P. D. A. Harvey pulls together the evidence which shows that the years 1180-1220 were a time of inflation so violent that they take their place with the sixteenth and twentieth centuries. The causes to which he attributes the inflation are debatable, but it was predictable that from it came an endeavour to keep their incomes abreast of a soaring cost of living, it spurred landlords to make the most of their land and to press to their rights over the dependent peasantry. I. Kershaw's essay on the crisis

of 1215-1222, the first adequate discussion of this episode in English history, takes us to the end of the same story. That crisis was a pointer to limitations, beyond which medieval economic development failed to go. By 1215 population had grown to a point where virtually all available land had been brought into agricultural use and where a good harvest was needed to provide adequate food supplies; the bad harvests of 1215-17 meant famine and steeply increased mortality; and those disasters were accompanied by heavy losses of livestock, especially ploughoxen. These blows struck at the basis of the agrarian boom which had been initiated by the great inflation and opened a period during which the economy, so long expanding, began to display many signs of contraction.

From basic economic trends the collection turns to specific social groups. In an essay which has become current learning Sally Harvy shows how modest was the endowment of land provided to most of the Norman knights and charters the process which transformed the knight into an aristocratic figure; and R. H. Hilton points to the depressing status of large sections of the English peasantry. The fact that this decline in peasant fortunes was in full flood in the generation around 1200, when landlords were striving to protect their real incomes in face of the great inflation, is hardly an accidental coincidence. C. Dyer and Barbara J. Harris, on the other hand, deal with the fifteenth century after plague mortality had reversed the bargain in the positions of 1200, so that peasants were able to refuse to pay some charges and lords seemingly made inadequate attempts to collect arrears. This, indeed, might seem to the peasantry to be a golden age, and the volume was destined to be brief.

The volume ends, finally, with a number of essays of ideological themes. Margaret Aston discusses the relationship between Lollardy and sectarian which, although it existed, was probably exaggerated by those seeking justification for new instruments of religious repression. Less closely related to the real world is the discussion engaging R. H. Hilton, J. C. Holt, M. Keen and T. A. Mason of that perennial ballad hero, Robin Hood. Was he based upon some real man and, if so, where did he live and rob? Was he merely the type of an unruly country gentleman or a "social bandit"? Or was he different things to different audiences at different times? The debate, happily, is not closed and will doubtless continue. In that respect it is a fitting conclusion to a book containing the record of many fruitful debates.

Edward Miller

## Reviewers

Clyde Binfield, author of *George Williams and the YMCA: A Study in Victorian Social Attitudes*, is senior lecturer in history at the University of Sheffield.

D. G. Boyce, author of *Englishmen and Irish Troubles*, lectures in government at University College, Swansea.

Derek Dorsett, reader in marine biology at the University of North Wales, Bangor.

B. F. Duckham is senior lecturer in economic history at the University of Strathclyde.

Richard Geary is lecturer in the department of German studies at the University of Lancaster.

Richard Grossby is fellow of Jesus College, Oxford.

Gerald Hodgett, reader in history at King's College, London, is author of *A Book of Medieval Recipes from a MS in Samuel Pepys's Library*.

Edward Miller, Master of Fitzwilliam College, Cambridge, is joint editor of *Cambridge Economic History of Europe* volume 3 and *Historical Studies of the English Peasantry*.

Agathe Ramon is fellow of Somerville College, Oxford.

Kevin Sharpe is a research fellow at Orkney College, Orkney.

M. R. C. Symons, professor of physical chemistry at the University of Leicester, is co-author of *The Structure of Inorganic Radicals*.

## Inheritors

Family and Inheritance: Rural Society in Western Europe 1200-1800  
edited by J. Goady, Joan Thirk and E. P. Thompson  
Cambridge University Press, £8.80  
ISBN 0 521 21246 4

This volume—a *Past and Present* publication—is a pioneering work and the contributors to it have themselves nearly all played a part during the last decade in the development of demographic history in this country or in Europe.

There are 10 essays on different aspects of inheritance and family structure in rural western Europe of the pre-industrial era. The contributions vary in length and J. P. Cooper's wide-ranging yet detailed survey of the patterns of inheritance and settlement by great landowners from the fifteenth to the eighteenth centuries could well stand on its own as a useful monograph.

Professor Jack Goady, after an admirable introduction, points out in his chapter that in Europe, in contrast to Africa, the father's property descended to daughters rather than to his brothers' sons. In 50 per cent of families would have daughters and no sons, women could become important landholders: these heiresses married men of roughly similar wealth and status.

Nearly all the contributors deal to some degree with the system of primogeniture (or ultimogeniture) as contrasted with partible inheritance, which is the major theme of the book. The practice of one system or the other had profound effects upon the structure of the family—joint, stem or nuclear—and upon the agrarian economy of western Europe. Jack Goady shows what these general effects were and demonstrates that primogeniture did not necessarily leave younger children unprotected for.

Professor Emmanuel Le Roy Ladurie contrasts the *preciput* common in the Midi with the complete equality of inheritance of all children in Normandy and the Paris-Orleans zone. In Normandy whatever children had been given during the father's lifetime had to be brought back at his death and shared equally between all sons and daughters. In other areas of western France the younger sons also partook in this division.

Lutz K. Berkner deals with areas of Germany where inheritance was partible and with those where it was impartible. He contrasts two places showing how, where partible inheritance is the law, the number of holdings increased and, as a result, the number of nuclear families, whereas the impartible areas contained many more stem families. David Sheehan moves to different ground in writing on aspects of kinship: he examines districts where the in-coming spouse has no rights in her husband's property if no heirs are produced and where, in such an event, she returns to her own family on her husband's death. Here the bride's kinship group show a continuing interest until heirs are born.

Cleely Towell and Margaret Spufford deal with inheritance customs in the Midlands (Leicestershire) and Cambridgeshire with great clarity. Joan Thirk discusses some of the testaments written in Europe between 1500 and 1700 which argued the case against primogeniture—at a time when impartible inheritance was advancing it was much opposed.

In conclusion, E. P. Thompson writes about "distinctions, tensions and how incompetent widows have lost their holding might regain it in some places by riding to court or by tampering backwards, while V. G. Kiernan contributes a sweeping essay on private property in history. In a composite work of this nature some overplays are inevitable and the excellent glossary does not explain all the terms used, some in foreign languages and some in archaic English, but these are slight faults in a book that is of outstanding importance to the historian and the sociologist.

Gerald A. J. Hodgett

## New from Heinemann

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### Cold War to Détente

Colin Bowen and Peter Moonen

A clear and up-to-date study of the transformation of world affairs from the simple East-West polarisation of the forties and fifties to the complex situation of the seventies.  
*Studies in Modern History* £5.00 £2.25 paperback

### Forthcoming

### Workshop of the British Empire

Michael S. Moss and John R. Hume

An illustrated study of the industries of the West of Scotland from the nineteenth century to the present day, which describes how the iron founding, engineering and shipbuilding industries came to dominate the imperial markets and the decline which was to follow. The book is lavishly illustrated throughout with contemporary photographs and drawings, most of which have never been published before. *Published 28th February* £12.50  
Special price before 26th April £9.50

### A History of Zambia

Andrew Roberts

A history of Zambia from the early Stone Age until the completion of the Tanzam Railway. A great deal of archaeological and historical work has been done on the Savanna region and Dr Roberts brings the published and unpublished materials together to form a coherent and readable history of the whole area which focuses on the central Zambezi.  
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48 Charles Street, London W1X 8AH

### Christoph M. Klimmich

#### GERMANY AND THE LEAGUE OF NATIONS

This study sheds light on the history of both the League of Nations itself and Germany (Germany was admitted in 1926, but withdrew in 1933). Germany's relations with the League are seen as a mirror of the domestic fortunes of Weimar and as an indication of how far republican Germany had broken with the traditions of the past. £13.15

### Joseph Hamburger

#### MACAULAY AND THE WHIG TRADITION

The conventional interpretation of Macaulay as a liberal Whig who believed in progress, civil liberty, toleration, science and laissez faire, is questioned by Hamburger, who argues that it has caused scholars to neglect Macaulay's intentions and the main theme of his writings. This new book presents a thoroughly documented account of Macaulay's evolution as a political thinker and a challenging analysis of his mature views. £13.15

### Jacques Lafaye

#### QUETZALCOATL AND GUADALUPE

*The formation of Mexican National Consciousness, 1537-1816*  
This study traces the emergence of an independent Mexican national consciousness through a myth-making process that forged a spiritual bond among Indians, mestizos, and creoles. Quetzalcoatl, the Aztec god-hero, was identified with St. Thomas who allegedly brought Christianity to Mexico long before the arrival of the Spaniards. Tonantzin, the Aztec mother-goddess, was associated with the Virgin of Guadalupe, under whose banner the armies of Hidalgo and Morelos began the struggle for full independence. *Foreword by Octavio Paz. Translated by Benjamin Keen.* £16.50

### THE UNIVERSITY OF CHICAGO PRESS

126 Buckingham Palace Road, London SW1W 9SD

### EDUCATION AND THE DISSENTING ACADEMIES

by M. D. Sleight and G. W. Roderick is one of the articles in the JANUARY issue. Others include: *Thomas Jefferson's VISIT TO ENGLAND, 1786* by Ross Watson; *PEROZESHAH AND THE SIXTH WAR*, by Patrick Turabul; *CHINA AND RUSSIA: THE BEGINNING OF CONTACT*, by William G. Sebald; *LONDRES XIV*, PARIS, by Andrew Toot; *THE SEVENTEENTH CENTURY AND AMERICANS*, by Steven R. Smith.

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# Classified Advertisements

## Index to Appointments Vacant, Wanted and other classifications

**Appointments vacant**  
**Universities**  
**Fellowships & Studentships**  
**Polytechnics**  
**Technical Colleges**  
**Colleges and Institutes of Technology**  
**Colleges of Education**  
**Colleges of Further Education**

**Colleges and Departments of Art**  
**Administration Overseas**  
**Government**  
**Industry**  
**Adult Education**  
**Librarians**  
**General Vacancies**

**Appointments wanted**  
**Other classifications**  
**Awards**  
**Announcements**  
**Exhibitions**  
**For Sale and Wanted**  
**Courses**  
**Holidays and Accommodation**  
**Typing and Duplicating**

### Universities



Applications are invited for the following posts, for which applications close on the dates shown. SALARIES (unless otherwise stated) are as follows: Professor \$425,007; Associate Professor \$424,971; Senior Lecturer \$418,788 to \$423,810; Lecturer \$413,880 to \$418,310; Tutor \$411,618 to \$411,484. Further details, conditions of appointment and application form, where applicable, may be obtained from the Association of Commonwealth Universities (App.), 26 Gordon Square, London WC1H 0PF.

University of New England  
 Armidale, New South Wales  
**ASSOCIATE PROFESSOR—DEPARTMENT OF GEOGRAPHY**

The appointee will be expected to provide academic leadership in teaching and research in urban and social geography (economic/behavioural/land politics). The Department's special research interests are: land use, behaviour, locational decision making, urban transport, rural/urban fringe development and regional planning. The appointee will be involved in internal and external teaching, postgraduate supervision and theoretical and applied research.  
 February 15, 1977.

Griffith University  
 Brisbane  
**ECONOMIST—CHINA**  
 A vacancy exists for an economist who has specialized in China, to do research and to teach undergraduate courses on the Chinese economy and to assist with the teaching of basic economic theory.  
 Salary \$A11,851 to \$A18,389.  
 March 31, 1977.

University of Tasmania  
**CHAIR OF ACCOUNTING**

Recently established, the appointee will be head of the Department of Accounting which is responsible for courses in accounting, commercial law, processing and commercial law. Research interests currently include the development of data-base management systems, cost value accounting and financial analysis, trends in asset realizations by Australian companies, information requirements in Australian corporate combinations, the use of financial information by Australian governmental regulatory authorities, developments in socio-economic accounting and consumer protection legislation.  
 March 14, 1977.

**CHAIR OF ADMINISTRATION**

Candidates should have a broad interest in the field of administrative studies, with particular reference to public administration, organizational theory or policy studies, and be prepared to take the leadership in the development of the discipline at both undergraduate and graduate levels.  
 March 14, 1977.

**CHAIR OF ENGLISH**

Vacant on the death of Professor F. R. McAlvey. The Department conducts and supervises research in several periods, principally medieval, renaissance and 19th century, and in American literature.  
 March 14, 1977.

University of Adelaide  
**LECTURER OR SENIOR LECTURER IN LAW**

Applicants should have, preferably, an Honours degree in law and postgraduate academic or professional experience, or both. Duties will include teaching undergraduate courses and the successful applicant will be expected to participate in research activities. Preference may be given to candidates whose interests include Taxation Law and Procedure.  
 February 5, 1977.

**TUTOR IN GERMAN**

To begin duty as soon as possible.  
 A candidate should have a good Honours degree in German or its equivalent and a high degree of fluency in spoken German.  
 February 28, 1977.

Murdoch University  
 Perth, Western Australia

**LECTURER/SENIOR LECTURER IN ENVIRONMENTAL SYSTEMS MANAGEMENT**

School of Environmental and Life Sciences  
 (Dean, Professor J. F. Loneragan)  
 The appointee will assist in the development of courses and research in Environmental Science, with particular emphasis on environmental modelling, systems analysis and management. The appointee should have a basic training in the life sciences, with strong secondary experience in the use of computers in environmental management and the modelling of ecological systems. Applicants should have had experience in at least one of the following areas: Air Quality systems; Coastal and estuarine management; Wetland Studies; Management of pests and weeds; Park and Wildlife management; Water resource management. Research experience equivalent to Ph.D. level is necessary.  
 Murdoch University, Western Australia's second university, admitted its first students in February, 1975. The University is committed to taking a fresh approach to higher education, with the goal of responding directly to the conditions and needs of the late twentieth century. This is reflected in admission policies, organizational structures, programmes of study, philosophies of teaching and recruitment of staff.  
 The University is organized as a system of schools, each headed by the Dean of each school having both academic and administrative responsibility.  
 February 22, 1977.

University of Sydney  
**CHAIR OF PHARMACEUTICS**

Applicants are invited for the Chair which became vacant on the resignation of Professor J. Swarbrick to become Dean of the School of Pharmacy in the University of London.  
 February 25, 1977.

**CHAIR OF PLANT BREEDING**

Faculty of Agriculture  
 Applications are invited for the Chair which will become vacant on the retirement of Professor J. A. Watkin who at present holds the Chair of Agricultural Botany (Plant Breeding).  
 February 25, 1977.

**PROFESSOR OF COMMUNICATION STUDIES**

School of Human Communication  
 The successful candidate will be expected to exercise leadership in the development of a revised undergraduate programme in communication studies and to establish research and graduate study in this area.  
 As a result of a recent review of communication studies in the University, it has been decided that its social and behavioural science aspects should be emphasized in the future development of the programme, and that its thrust should be principally theoretical and methodological. Beyond this, no detailed prescription has yet been developed and the successful candidate, as the senior academic in the programme, will be expected and encouraged to advise the University on appropriate ways in which this general policy may be implemented.  
 Murdoch University, Western Australia's second university, admitted its first students in February, 1975. The University is committed to taking a fresh approach to higher education, with the goal of responding directly to the conditions and needs of the late twentieth century. This is reflected in admission policies, organizational structures, programmes of study, philosophies of teaching and recruitment of staff.  
 The University is organized as a system of schools, each headed by the Dean of each school having both academic and administrative responsibility.  
 February 22, 1977.

**SUPERVISOR OF PROFESSIONAL TRAINING**

This is a senior appointment in professional teaching area with responsibility for directing growth and development of all professional courses. Applicants should have extensive experience in practice and teaching of at least one area of social work and competence in research and must possess professional social work qualifications, preferably having completed relevant doctoral studies. Appointment will be at Senior Lecturership level.  
 February 28, 1977.

University of Melbourne  
**CHAIR OF PHARMACEUTICS**

Applications are invited for the Chair which became vacant on the resignation of Professor J. Swarbrick to become Dean of the School of Pharmacy in the University of London.  
 February 25, 1977.

**CHAIR OF PLANT BREEDING**

Faculty of Agriculture  
 Applications are invited for the Chair which will become vacant on the retirement of Professor J. A. Watkin who at present holds the Chair of Agricultural Botany (Plant Breeding).  
 February 25, 1977.

**LECTURER IN MECHANICAL ENGINEERING (2)**

The successful applicant must hold a medical qualification permitting registration in Victoria.  
 SALARY \$A34,087.  
 March 31, 1977.

**CHAIR OF INORGANIC CHEMISTRY**

The Chair of Inorganic Chemistry, which is one of the three Chairs in the School of Chemistry, will be vacant on the retirement of Professor D. Stranks from February 28, 1977 in accordance with the terms of an agreement with the University of Adelaide.  
 March 31, 1977.

**LECTURER IN FIELD OF COMMUNITY WORK**

Appointee will take major responsibility for teaching and supervising community work. Applicants must possess professional social work qualifications and teaching and field experience.  
 February 28, 1977.

University of Melbourne  
**JAMES STEWART CHAIR OF SURGERY**

Applications are invited for this Chair from which Professor Maurice Ewing retired at the end of 1977.

**CHAIR OF CONSERVATIVE DENTISTRY**

The Professor will be responsible for teaching and research in Conservative Dentistry at undergraduate and postgraduate levels leading to degrees of the University of Melbourne.  
 The successful applicant must hold a dental qualification enabling registration by the Dental Board of Victoria.  
 SALARY, plus a loading of \$A2,500 per annum.  
 April 29, 1977.

**CHAIR OF METALLURGY**

Applications are invited for appointment to the Chair of Metallurgy which is vacant following the appointment of Professor H. W. Werner to the Chair of Metallurgy in the Commonwealth Scientific and Industrial Research Organisation. The Chair responsibilities are intended to include Mining.  
 March 31, 1977.

**LECTURER—DEPARTMENT OF PSYCHOLOGY**

Applicants should preferably have a doctorate in Psychology and should have research and teaching skills in the area of social psychology and quantitative methods. Some interest or experience in the field of occupational psychology would be an advantage. It is hoped that the successful applicant will be able to take up the appointment as soon as possible.  
 February 28, 1977.

**CHAIR OF PLANT BREEDING**

Faculty of Agriculture  
 Applications are invited for the Chair which will become vacant on the retirement of Professor J. A. Watkin who at present holds the Chair of Agricultural Botany (Plant Breeding).  
 February 25, 1977.

**BIRMINGHAM THE UNIVERSITY OF ASTON DEPARTMENT OF ELECTRICAL ENGINEERING**

Applications are invited for a Lectureship in Psychology, or of such other title as may be arranged. Applicants should preferably be in the early stages of their professional development, psychometric, or other areas of human psychology. Ability to contribute to the development of the department would be an advantage.  
 The salary scale is £3,355 to £6,000 with dependent allowances. Applicants will be invited to attend an interview in Birmingham. The successful applicant will be expected to take up the appointment as soon as possible.  
 Closing date: 28th February, 1977. Further particulars may be obtained from The Personnel Officer, The University of Aston, Birmingham B4 7ET, England. (Please quote Ref. 77/1285).

**BIRMINGHAM THE UNIVERSITY OF ASTON MANAGEMENT CENTRE**

Applications are invited for a Lectureship in the Economics, Econometrics, Statistics and Marketing Subject Group. The successful applicant will be expected to contribute to the development of the Centre in one or more of the above areas and to undertake other duties as may be required. The successful applicant will be expected to take up the appointment as soon as possible.  
 Closing date: 28th February, 1977. Further particulars may be obtained from The Personnel Officer, The University of Aston, Birmingham B4 7ET, England. (Please quote Ref. 77/1285).

### Universities continued

## Rhodes University

Grahamstown South Africa  
 Applications are invited for the following posts:

**(a) Academic PROFESSOR OF PHARMACY**  
 (Applicants to state area of speciality.)  
 Date of Assumption of Duty: 1/1/78

**SENIOR LECTURER/LECTURER IN ICHTHYOLOGY**  
 as soon as possible

**SENIOR LECTURER/LECTURER IN MATHEMATICAL STATISTICS**  
 as soon as possible

**SENIOR LECTURER/LECTURER IN COMPUTER SCIENCE**  
 as soon as possible

**LECTURER/JUNIOR LECTURER IN PHYSICS**  
 1/7/77

**(b) Non-Academic STUDENT ADVISER**  
 as soon as possible

**ELECTRONICS TECHNICIAN (X-RAY ANALYSIS AND MICROPROBE)**  
 in the Department of Geology  
 as soon as possible

The salary scales are:  
**PROFESSOR**  
 R10,800 x 450-12,800 x 600-13,800 per annum

**SENIOR LECTURER**  
 R8,460 x 380-9,900 x 450-11,250 per annum

**LECTURER**  
 R6,300 x 360-9,180 per annum

**JUNIOR LECTURER**  
 R4,920 x 180-5,100 x 240-6,300 x 360-6,660 per annum

**STUDENT ADVISER**  
 R7,020 x 360-9,540 per annum

**ELECTRONICS TECHNICIAN**  
 R4,920 x 180-5,100 x 240-6,080 per annum  
 (Note: £1 sterling equals approximately R1.45)

In addition a supplement of 10 per cent on the above scales and a vacation savings bonus are payable. The successful applicants will become members of the University's pension and medical aid schemes.

Further particulars and application forms may be obtained from the Scientific Counsellor, c/o South African Embassy, Chichester House, 278 High Holborn, London WC1V 7HE.

One copy of the application should be sent to the Scientific Counsellor and one copy together with a recent photograph direct to the Registrar, Rhodes University, Grahamstown, South Africa by 11th February 1977.

## UNIVERSITY OF SURREY

### HEAD OF DEPARTMENT AND PROFESSOR OF MECHANICAL ENGINEERING

Applications are invited for the Chair of Mechanical Engineering and Headship of the Department of Mechanical Engineering, which becomes vacant at the end of the present session following the retirement of Professor J. M. Zarek from the post. The person appointed should have a strong commitment to the education of engineers for service in British industry to the present undergraduate course of four years (including a year in industry), and to the development of short postgraduate courses. A proven record in research is important and a research interest consistent with those already in the department would be an advantage. Salary, in the professional range, will be not less than £8,106 per annum, with U.S.S. benefits. Further particulars may be obtained from the Academic Registrar (L.F.G.), University of Surrey, Guildford, Surrey GU2 5XH, or telephone Guildford 71281 extension 452. Applications, in the form of a curriculum vitae, together with the names and addresses of three referees, should be sent to the same address by 28 February, 1977.

### BELFAST THE QUEEN'S UNIVERSITY DEPARTMENT OF PSYCHOLOGY

Applications are invited for a Lectureship in Psychology, or of such other title as may be arranged. Applicants should preferably be in the early stages of their professional development, psychometric, or other areas of human psychology. Ability to contribute to the development of the department would be an advantage.  
 The salary scale is £3,355 to £6,000 with dependent allowances. Applicants will be invited to attend an interview in Belfast. The successful applicant will be expected to take up the appointment as soon as possible.  
 Closing date: 28th February, 1977. Further particulars may be obtained from The Personnel Officer, The University of Belfast, Belfast BT7 1JN, Northern Ireland. (Please quote Ref. 77/1285).

### CANADA THE UNIVERSITY OF OTTAWA DEPARTMENT OF BOTANY

Applications are invited for a Lectureship in Botany, or of such other title as may be arranged. Applicants should preferably be in the early stages of their professional development, or have a Ph.D. and a significant research record. The successful applicant will be expected to take up the appointment as soon as possible.  
 Closing date: 28th February, 1977. Further particulars may be obtained from The Personnel Officer, The University of Ottawa, Ottawa, Ontario, K1N 6N5, Canada. (Please quote Ref. 77/1285).

### ABERDEEN THE UNIVERSITY RESEARCH ASSISTANT IN SOILOLOGY

A Research Assistant is required to work on a one year contract. The successful applicant will be expected to take up the appointment as soon as possible. The salary scale is £3,355 to £6,000 with dependent allowances. Applicants will be invited to attend an interview in Aberdeen. The successful applicant will be expected to take up the appointment as soon as possible.  
 Closing date: 28th February, 1977.

### CAMBRIDGE SELWYN COLLEGE ELECTION OF FELLOW-COMMEMORATOR

The Governing Body of Selwyn College propose to elect a Fellow-Commemorator for the year 1977-78. The Fellow-Commemorator will have specific duties but will not be expected to reside in College for the period of office. The salary will be £2,400 per annum, plus a grant of up to £200 for expenses. The successful candidate will be expected to take up the appointment as soon as possible.  
 Applications should be made before 28 February, 1977, on the application form, which may be obtained from the Master, Selwyn College, Cambridge CB2 3RQ.

### CAMBRIDGE THE UNIVERSITY HUMAN BIOLOGY DEPARTMENT

Applications are invited from candidates for the following posts: Lecturer in Human Biology, Lecturer in Human Physiology, Lecturer in Human Anatomy, Lecturer in Human Embryology, and Lecturer in Human Development. The successful applicant will be expected to take up the appointment as soon as possible.  
 Closing date: 28th February, 1977. Further particulars may be obtained from The Personnel Officer, The University of Cambridge, Cambridge CB2 3RQ.

### CAMBRIDGE THE UNIVERSITY PURE MATHEMATICS

Applications are invited for the following posts: Lecturer in Pure Mathematics, Lecturer in Applied Mathematics, Lecturer in Mathematical Physics, Lecturer in Mathematical Statistics, Lecturer in Mathematical Economics, Lecturer in Mathematical Biology, Lecturer in Mathematical Chemistry, Lecturer in Mathematical Engineering, Lecturer in Mathematical Medicine, Lecturer in Mathematical Agriculture, Lecturer in Mathematical Law, Lecturer in Mathematical History, Lecturer in Mathematical Philosophy, Lecturer in Mathematical Literature, Lecturer in Mathematical Music, Lecturer in Mathematical Art, Lecturer in Mathematical Architecture, Lecturer in Mathematical Engineering, Lecturer in Mathematical Medicine, Lecturer in Mathematical Agriculture, Lecturer in Mathematical Law, Lecturer in Mathematical History, Lecturer in Mathematical Philosophy, Lecturer in Mathematical Literature, Lecturer in Mathematical Music, Lecturer in Mathematical Art, Lecturer in Mathematical Architecture, Lecturer 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Lecturer in Mathematical Agriculture, Lecturer in Mathematical Law



Universities continued

UNIVERSITY OF SINGAPORE FACULTY OF DENTISTRY

Applications are invited for teaching appointments in the Departments of Operative Dentistry and Prosthetic Dentistry from candidates who should possess relevant higher professional qualifications...

THE UNIVERSITY OF MANCHESTER MANCHESTER BUSINESS SCHOOL APPOINTMENT OF DIRECTOR

The Council of the Manchester Business School proposes to appoint a Director of the School on or after September 1st, 1977. The School has over 100 post-graduate and 200 post-experience students a year...

UNIVERSITY COLLEGE DUBLIN

Applications are invited for two posts, each post at the rank of Lecturer in the Department of Education...

HONG KONG THE UNIVERSITY

Applications are invited for a post of Lecturer in the Department of Education...

BULL THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

HONG KONG THE UNIVERSITY

Applications are invited for three posts of Lecturer in the Department of Education...

LONDON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

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Applications are invited for the post of Lecturer in the Department of Education...

LONDON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

IRELAND THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

JORDAN THE UNIVERSITY

The Faculty of Engineering and Technology, University of Jordan is pleased to announce the appointment of a Lecturer in the Department of Mechanical Engineering...

JORDAN THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of Lecturer in the Department of Education...

LONDON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

LONDON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

THE OPEN UNIVERSITY

Applications are invited for three posts in the Faculty of Arts...

LONDON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

LONDON THE UNIVERSITY

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LONDON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

SHEFFIELD THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

SOUTHAMPTON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

SOUTHAMPTON THE UNIVERSITY

Applications are invited for the post of Lecturer in the Department of Education...

STIRLING THE UNIVERSITY

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WARWICK THE UNIVERSITY

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THE TIMES HIGHER EDUCATION SUPPLEMENT 21.1.77

Polytechnics continued

DUNDEE COLLEGE OF TECHNOLOGY HEAD OF DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

The college is a Scottish central institution with a substantial and growing range of degree and diploma courses. The department of electrical and electronic engineering provides courses leading to the higher national certificate, together with various specialist short courses...

Further particulars and application form obtainable from the Principal, Dundee College of Technology, Bell Street, Dundee DD1 1HG, to whom completed application forms should be returned by 4 February 1977.

DUNDEE COLLEGE OF TECHNOLOGY LECTURESHIP IN ACCOUNTANCY

Applicants should be honours graduates or hold appropriate equivalent professional qualifications; they should have substantial practical or research experience and/or have substantial experience of teaching at undergraduate or postgraduate level...

LECTURESHIP IN CIVIL ENGINEERING

The person appointed will be able to teach up to honours degree level and applicants should be civil engineering graduates with appropriate teaching and research/practical experience. They should have a special interest in Hydraulics, Hydrology, Public Health or Soil Mechanics...

LONDON POLYTECHNIC OF THE FACULTY OF ADMINISTRATIVE STUDIES

Applications are invited for the post of Lecturer in the Department of Education...

NORTH STAFFORDSHIRE THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

NORTH STAFFORDSHIRE THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

WOLVERHAMPTON THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

WOLVERHAMPTON THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

ABERDEEN ROBERT GORDON'S INSTITUTE OF TECHNOLOGY

SCHOOL OF SOCIAL STUDIES SENIOR LECTURER IN PUBLIC ADMINISTRATION

To contribute to established courses and act as Course Leader for Social and Public Administration option of proposed degree in Social Studies. Applicants should have Honours or Higher Degree in Public Administration, or related disciplines, and relevant experience. Salary in range £8,312-£8,028 per annum.

Details from Chief Administrative Officer, Robert Gordon's Institute of Technology, Schoolhill, Aberdeen AB9 1FR.

ULSTER COLLEGE THE NORTHERN IRELAND POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

LECTURESHIP IN CIVIL ENGINEERING

The person appointed will be able to teach up to honours degree level and applicants should be civil engineering graduates with appropriate teaching and research/practical experience.

LONDON POLYTECHNIC OF THE FACULTY OF ADMINISTRATIVE STUDIES

Applications are invited for the post of Lecturer in the Department of Education...

NORTH STAFFORDSHIRE THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

NORTH STAFFORDSHIRE THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

WOLVERHAMPTON THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

WOLVERHAMPTON THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

Polytechnics continued

ABERDEEN ROBERT GORDON'S INSTITUTE OF TECHNOLOGY

To contribute to established courses and act as Course Leader for Social and Public Administration option of proposed degree in Social Studies. Applicants should have Honours or Higher Degree in Public Administration, or related disciplines, and relevant experience.

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NORTH STAFFORDSHIRE THE POLYTECHNIC

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WOLVERHAMPTON THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

WOLVERHAMPTON THE POLYTECHNIC

Applications are invited for the post of Lecturer in the Department of Education...

COMPUTER MUSIC

Professor Barry Vercoe, Director of Computer Music Facilities at Massachusetts Institute of Technology and author of 'Music 960', the foremost language for computer music synthesis, will lecture at The City University, London...

Awards

HISTORICAL RESEARCH GRANTS. Applications are invited for grants to support research in the field of history.

Holidays and Accommodation

RIGHT-FREE HOLIDAYS. Many houses with college property have right-free holidays available for students.

Institute of Higher Education

ROEHAMPTON INSTITUTE OF HIGHER EDUCATION

Applications are invited for the following post at SOUTHDALE COLLEGE. PRINCIPAL LECTURER or SENIOR LECTURER in MULTICULTURAL STUDIES.

The person appointed will be responsible for leading the team teaching a Diploma Course in Education for a Multicultural Society and for coordinating contributions from this area of study to PGCE, BEd, BA, BH and other courses.

Administration

Newcastle upon Tyne Polytechnic

Chief Administrative Officer's Department SENIOR ADMINISTRATIVE OFFICER (£6,708-£7,386)

To be responsible to the Chief Administrative Officer for the central general administrative and operational services of the Polytechnic and to assist him with specific aspects of the maintenance and development of the services provided by the Department.

Announcement

CHARITY COMMISSION. Scheme for the regulation of charities.

BRITISH RED CROSS SOCIETY

YOUTH OFFICERS. Applications are invited for youth officers in various areas.

REMINDER

Copy for Classified Advertisements in the Times should arrive not later than 10.30 on Monday preceding the date of publication.



Colleges of Higher Education

Bulmershe College of Higher Education

1. Head of Learning Resources

A new senior post has been created with responsibility for a major library and for managing College learning resources. The College is looking for a graduate Librarian with a strong interest in organising multi-media learning provision in the higher education sector. This post is being re-advertised as it has now been upgraded to Head of Department Scale IV. Previous applicants need not re-apply.

Salary scale: £8,756-£7,632 (+ £312 supplement)

2. Tutor in Film and Drama Studies

A Tutor is required to teach in the major and minor courses on Film and Drama Studies in the C.N.A.A. Combined Studies B.A./B.A.(Hons.) which starts in September. Interest in the following areas will be valuable: realism in film and theatre; linguistic, semiological and sociological approaches to study of the performing arts; European cinema.

Salary scale (Lecturer II/Senior Lecturer): £3,279-£5,955 (+ £312 supplement).

Further particulars and application forms, returnable by 4th February, 1977, are available from: Principal's Secretary, Bulmershe College of Higher Education, Earley, Reading RG6 3HT. (Telephone: Reading 863357.)

Courses

Diploma in Management Studies (Education)

Applications are invited for the programme leading to the Diploma in Management Studies (Education) which will be offered on a day release basis over 2 years, commencing September, 1977. The course is based upon basic foundation areas which lead to a series of modules, each dealing with a major aspect of management in the Education Service. It is intended for those people holding a position of some administrative responsibility, with a career commitment in Education Management (in schools, colleges, polytechnics, universities, local government and educational services). Further details may be obtained from the Registrar, Ref. A0136, Anglia Regional Management Centre, Duxbury Park, Colchester, Essex CH3 4AT. Tel. Duxbury 2141.

ARMC Anglian Regional Management Centre

NORTH EAST LONDON POLYTECHNIC-ESSEX COUNTY COUNCIL

COUNTY OF SOUTH GLAMORGAN SOUTH GLAMORGAN INSTITUTE OF HIGHER EDUCATION

Principal E. J. Brent, Ph.D., M.A., F.R.S.A., F.C.P., Faculty of Education

Postgraduate School of Art Education The following course in ART EDUCATION is offered for teachers/lecturers in Art & Design for the Academic Session 1977-78.

M.Ed. (Art Education)

Applications for this course are recommended at the earliest possible date. Further information and application forms obtainable from: Head of Postgraduate School of Art Education, Faculty of Education, South Glamorgan Institute of Higher Education, Howard Gardens, Cardiff. Tel. (0222) 44761.

KENT

THE UNIVERSITY AT CANTERBURY THE LANGUAGE CENTRE POSTGRADUATE COLLEGE IN APPLIED LINGUISTICS

This full-time one-year course leads to the Diploma in Applied Linguistics. The course is designed for those who wish to pursue a career in the field of Applied Linguistics. It provides a solid foundation in the theory and practice of Applied Linguistics, and includes a research project. The course is taught by leading experts in the field. Applications should be sent to the Registrar, University of Kent, Canterbury, Kent, CT2 7NF.

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THE UNIVERSITY AT CANTERBURY THE LANGUAGE CENTRE POSTGRADUATE COLLEGE IN APPLIED LINGUISTICS

This one-year Diploma course is designed for those who wish to pursue a career in the field of Applied Linguistics. It provides a solid foundation in the theory and practice of Applied Linguistics, and includes a research project. The course is taught by leading experts in the field. Applications should be sent to the Registrar, University of Kent, Canterbury, Kent, CT2 7NF.

Garnett College

Advanced Courses of Study in Further Education

Application is invited for the following courses: MASTERS DEGREE (in Education) University of London

Two years' part-time study. Specialist in extended study of further education. Enables students to undertake research in further education. Candidates must have initial teacher training and have reached a high level of achievement in the Diploma in Further Education or its equivalent.

DIPLOMA IN FURTHER EDUCATION University of London

One year full-time or three years' part-time study. Relates the study of further education to contemporary educational theory and to current social and economic developments. Students can further specialise in Psychology, Sociology, Educational Technology, Educational Administration and Management, Aspects of Counselling, etc. is recognized by a number of universities as a 'qualifying' examination for courses for higher degrees for both graduates and non-graduates. Candidates should have reasonably substantial teaching or administrative experience in further education or industrial training.

BACHELOR OF EDUCATION

Council for National Academic Awards

Three or four years' part-time study. Extends the educational studies of the Certificate in Education course. Prepares candidates for further study and research in further education. Candidates should be serving teachers with an initial teaching qualification and a minimum of two years' experience.

Candidates for all courses should apply as soon as possible and enclosing the courses in which they are interested: The Principal, Garnett College, Dunshire House, Northampton Lane, London SW15 4JH (01-276 6533).

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ESSEX THE UNIVERSITY OF CANTERBURY DEPARTMENT OF GOVERNMENT FOR M.A. DEGREE

Five alternative M.A. degrees are available to students who have completed the first year of the M.A. programme. The M.A. programme is designed to provide a broad and a more specialized education. The M.A. programme is designed to provide a broad and a more specialized education. The M.A. programme is designed to provide a broad and a more specialized education.

THE UNIVERSITY OF CANTERBURY DEPARTMENT OF GOVERNMENT FOR M.A. DEGREE. Applications are now invited from honours graduates who have completed the first year of the M.A. programme. The M.A. programme is designed to provide a broad and a more specialized education. The M.A. programme is designed to provide a broad and a more specialized education.

SHEFFIELD THE UNIVERSITY DEPARTMENT OF GERMAN STUDIES 1977/78 Session

Applications are now invited from honours graduates who have completed the first year of the M.A. programme. The M.A. programme is designed to provide a broad and a more specialized education. The M.A. programme is designed to provide a broad and a more specialized education.

SURREY THE UNIVERSITY DEPARTMENT OF PHILOSOPHY M.A. IN PHILOSOPHY

Applications are now invited from honours graduates who have completed the first year of the M.A. programme. The M.A. programme is designed to provide a broad and a more specialized education. The M.A. programme is designed to provide a broad and a more specialized education.

BRISTOL WESLEY COLLEGE

Appointment of PRINCIPAL (initially) to be followed by a period of 12 months' probation. The post is full-time and involves a heavy workload. The post is full-time and involves a heavy workload. The post is full-time and involves a heavy workload.

Private colleges require an experienced and enthusiastic Head of School. The post is full-time and involves a heavy workload. The post is full-time and involves a heavy workload. The post is full-time and involves a heavy workload.

ilea INNER LONDON EDUCATION AUTHORITY

Inspectors of Further and Higher Education (District rank)

Inspector of Further Education required to inspect and advise on the development of education for the less able and the disadvantaged, and to be concerned with general and vocationally oriented general education with emphasis on basic education and numeracy. Applicants should have a graduate qualification, preferably in science or mathematics and relevant teaching experience in further education. (Post A)

Inspector of Art and Design Education required to inspect, advise upon and develop art and design studies, mainly in further and higher education establishments of the Authority. Applicants should possess appropriate qualifications and have had wide and distinguished teaching experience including some at a high level in a College of Art. Professional achievement in art or design is desirable. (Post B)

Salary range for both posts: £8,680 - £9,520 (inclusive of London Weighting) with possibility of progress to £10,546.

Further particulars and application forms from the Education Officer (EO) (Estab 2A11), Addington Street Annex, The County Hall, London SE1 7PB. Forms to be returned by 4 February 1977.

Oxford University Press Editors Philosophy and History

Oxford University Press seek two editors for their Academic Publishing Division.

One is needed to manage and develop the established philosophy list and to expand its political and social science content. This editor will be responsible to the Academic Publisher for commissioning and editing new books at university first-year level and above, and for maintaining the back list of some 300 titles.

The second will assist in the management and development of the history list. This will involve an important role in the commissioning and publishing of new books and the maintenance of an established back list.

Both jobs are based at Oxford, but involve establishing and maintaining contact with universities and polytechnics throughout the UK. The successful applicants are likely to have good arts degrees and relevant postgraduate experience.

Salaries in range £3200 to £4300.

Applications, with c.v., to Personnel Department (C.R. Bourne), Oxford University Press, Walton Street, Oxford OX2 6DP by 4th February.

COLLINS PUBLISHERS DICTIONARIES-TEMPORARY POST

We are seeking an EDITOR to join a small team working on new English dictionaries projects. Candidates should be educated to degree standard with good post-graduate experience in the field of English Language or Modern Literature. Specific dictionary experience is not necessary as training will be given. The post will be available for approximately two months in the first instance.

Please write giving full details of qualifications and experience to: Robin F. Jordan, COLLINS PUBLISHERS, 111 Cathedral Street, Glasgow G4 0ET.

General Vacancies

Hammersmith and West London College Airline Gardens, W8 7AF

Vice Principal

£9863 plus £402 Inner London Allowance

This Group 9 College carries an establishment of three Vice Principals. Each of the Vice Principals is expected to carry out both academic functions in relation to a group of departments, and administrative functions across the college as a whole. The college is seeking an educationist capable of senior managerial responsibility. Appropriate experience of teaching, of employment other than teaching and a sensitive approach to personal relationships are sought rather than any specific specialist area of academic knowledge. Application forms and further particulars from the Senior Administrative Officer (IC) to be returned by 9 February, 1977. Likely interview date 1 March, 1977.

INNER LONDON EDUCATION AUTHORITY

Lecturing Opportunities £3500-£6500

ICL Training provides over 200 courses on a range of computer and allied subjects for Managers, Systems Analysts, Designers, Programmers and Operators. Most of these courses are run at our Training Centres at Lilling and Windsor, but there is an increasing need to give courses elsewhere in the UK and overseas.

We are recruiting experienced, self-motivating Lecturers, aged 25-30 who are interested in a career in this expanding field. In addition to providing standard courses, Lecturers are expected to be able to determine training needs in respect of new products and techniques, and to modify existing courses for specific audiences and customers.

It is not essential for candidates to have computing experience, but they should be enthusiastic and stimulating trainers capable of inspiring postgraduate groups.

For an application form please write to Miss M.A. Bourne, ICL Beaumont, Old Windsor, Berkshire SL4 2JP. Interviews will be held during February, and offers will be made to successful candidates by early March.

International Computers ICL think computers-think ICL

NATIONAL ASSOCIATION OF TEACHERS IN FURTHER AND HIGHER EDUCATION

NATFHE invites applications for a

REGIONAL OFFICIAL

In the North East Region and Northern Ireland. Starting Salary £4,905 (under review from 1st April 1977).

Further details from Mr. Brady, NATFHE, Hamilton House, Mabledon Place, WC1H 9BH

Telephone 01-387 6806 Closing date: 10th February

UNIVERSITY OF DUBLIN Trinity College

CHAIR OF BIOCHEMISTRY (1980)

The Chair of Biochemistry (founded in 1860) will fall vacant on 30th September, 1977. Persons interested in this appointment should write for further particulars to:

The Secretary, Trinity College, Dublin 2 to whom applications should be sent, preferably, before 31st January, 1977.

Classified Advertisements

To advertise in The THES phone John Ludbrook 01-837 1234

THE TIMES Higher Education SUPPLEMENT

New Printing House Square, P.O. Box 7, Gray's Inn Road, London WC1A 8EZ



MURRAY PARK COLLEGE OF ADVANCED EDUCATION

Magill South Australia

Applications are invited from suitably qualified persons for the position of

HEAD OF SCHOOL of TEACHER EDUCATION

The post is initially offered as a contract for a period of three to five years with the possibility of further renewal.

Present Salary \$24,009

Applicants should have substantial experience at a senior level in teacher education. Further particulars and application forms are available from:

The Academic Secretary Murray Park CAE 15 Lorne Avenue MAGILL South Australia 5072

Closing date: Monday, 28 February, 1977

Technical Education in Kenya

Kenya Government posts, financially supported under the British Overseas Aid Programme, providing the opportunity to participate in the development of technical education in a country with an exciting and varied environment.

Applications are invited for the undermentioned posts, which are to be filled as soon as possible and will be on 2 1/2 to 3-year contracts.

Kenya Polytechnic (Nairobi)

Lecturer in Electrical Power

To teach Technical and Higher Diploma students. Organisation of course work. Degree HND or FTC. Industrial and Teaching experience.

Assistant Lecturer 1, Electronics

To teach Electronics to Technicians and Higher Diploma students. To develop relevant laboratory work. Supervision and organisation of laboratory work, maintenance workshop and stores. Degree or HND in Electronics. Recognised apprenticeship, Technician Training Certificate or Diploma. Industrial or teaching experience, specialising in Electronic Measurements and testing methods, Electrical/Electronic Drawing, Industrial Electronics.

Mombasa Polytechnic

Lecturer, Electronics

To teach Industrial Electronics, Solid State Devices and Applications, instrumentation. To develop existing electronics teaching facilities. To organise short courses in Industrial Electronics for mature engineers. HNC Electrical Engineering. Telecommunications subjects an advantage. Industrial and teaching experience.

This post offers the challenge of developing a new section established only 18 months ago. Note: Kenya grades do not correspond with UK grades.

SALARY Lecturer £5,188-£7,510 Assistant Lecturer 1 £4,110-£6,175

(inclusive of a normally tax-free supplement, reviewed annually, paid by the British Government under its aid programme, to citizens of the UK) plus a 25 per cent terminal gratuity on the basic salary; free passages; education allowances and holiday visit passages for children; an appointment grant up to £300 and an interest-free car loan up to £1,200 are payable in certain circumstances.

Application forms and further details obtainable from the Recruitment Unit, TETOC (Technical Education and Training Organisation for Overseas Countries), 35/37 Grosvenor Gardens, London SW1W 0BS. Ref: THES/UEE. Completed application forms should be returned to TETOC by 12th February, 1977.

